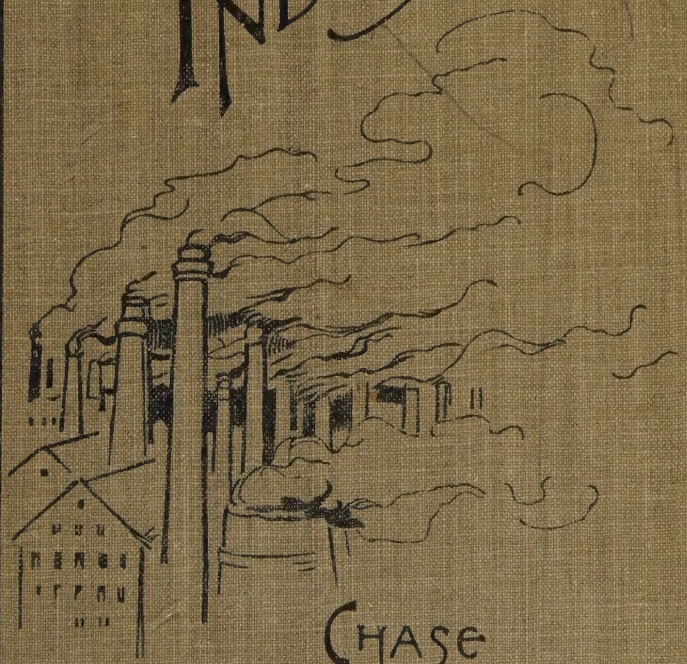
STORIES OF INDUSTRY



CHASE AND E. CLOW

VOL II.

Louis M. Heller

STORIES

OF

INDUSTRY.

VOLUME II.

By A. CHASE and E. CLOW.

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A COTTON MARKET IN TEXAS.

HISTORICAL COSTUMES.

STORIES OF INDUSTRY.

VOL. II.

CLOTHING.

THE sun is the source of heat and life. Some parts of the earth are so hot that the natives wear no clothes, but in our climate we are not safe from change of weather, from wet to dry or from hot to cold.

Clothes are worn to keep in the heat of the body. They can not warm us as do the fire and sun.

Coats, frock, shirts, with underclothing of several

kinds, and stockings, are made of the spun and woven fibres of wool, silk, flax and cotton. Wool and silk are animal fibres, flax and cotton plant fibres.

Wool forms the warm fleece of the sheep, which, when winter is over, is shorn off with a pair of shears, and converted into a warm coat for man.

Silk is spun from the mouth of a caterpillar.

Flax is a small plant, with a pretty blue flower, which grows in the fields. Its seed is the well-known linseed, in such great request for so many useful purposes.

Cotton, or cotton-wool, is the soft, downy covering of the seeds in the pod of the cotton-plant.

COTTON.

Cotton is a plant that needs a warm climate and a dry soil; it is therefore found in the warm temperate

and in the torrid zone of Asia, Africa, and America. This plant was discovered to be valuable for the manufacture of cloth long before the Christian Era. The Chinese are known to have manufactured cloth from cotton as early as 500 B. C., and in India there are old books in which cotton is mentioned, that were written eight hundred years before the birth of Christ. When Columbus discovered America he found cotton to be the chief material of clothing among the Indians. America proved to be so well suited to the growth of cotton that more was grown every year.

Seven-eighths of all the cotton used in the world is grown in our own country; ours is also the best that is raised; for these reasons we wish to learn something about United States cotton.

There are many kinds of cotton. Those most cultivated are from two to four feet in height. The pods are about the size of a small peach; when ripe, they burst open and permit the cotton to be easily gathered. The seeds are entangled in the fibres and must be gathered with them. The fibres are called staples. If they are long, the cotton is called long-staple cotton; if short, short-staple cotton.

Our best kind is a long-staple cotton that grows on a shrub. This thrives only on the sea-shore. Because it is especially cultivated on the islands at the mouth of the Savannah River it is called sea-island cotton.

A small quantity only is produced. A large part of the cotton raised in the country is a short-staple variety, which grows on a plant that dies to the ground each year. This is called upland cotton.

The sea-island cotton is grown along the coast of

PICKING COTTON.

Georgia, and in those parts of South Carolina and Florida which are adjacent to the Georgia coast.

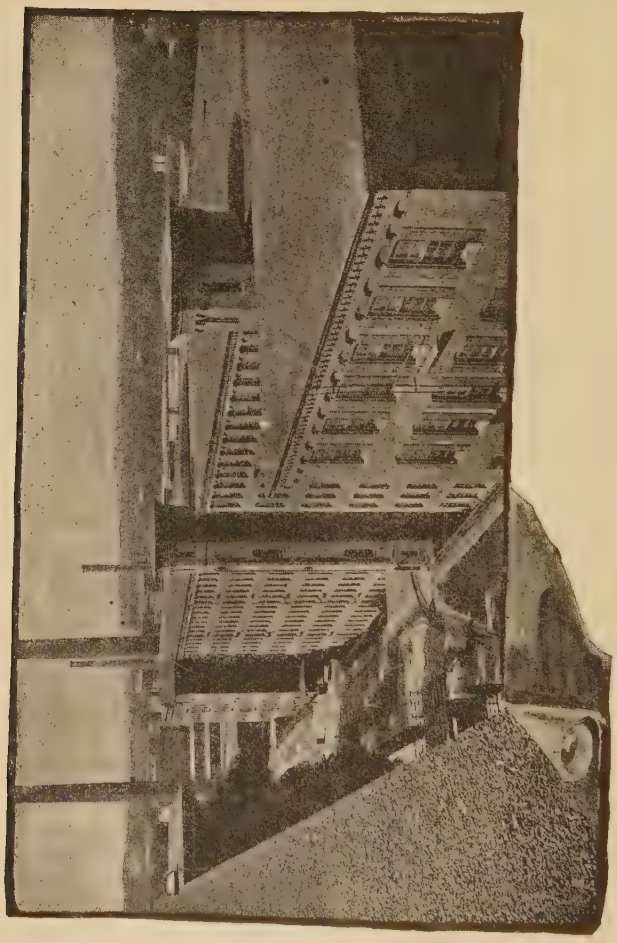
The pods in which the cotton forms are the size of a small peach; when ripe, however, they burst open and become about as large as an apple. The withered pods hold the fluffy cotton-wool so firmly that it

cannot readily escape and fall to the ground, but may be easily picked.

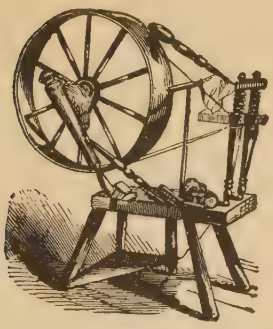
The seeds, however, are so entangled in the staples that it took a man an entire day to pick them from a pound of cotton. For this reason, but little was done in the way of cotton-raising, until about a hundred years ago.

About that time Eli Whitney, a Massachusetts man, invented a machine that cleans three hundred pounds of cotton much better and more quickly than a man can clean one pound. This machine is made in such a way that small teeth, something like those of a saw, seize the staples and drag them between the rollers, so near together that the seeds cannot pass through. It is called the cotton-gin; the last part of the word is a contraction for engine.

In Brazil cotton is largely cultivated, though cotton-picking does not there assume the importance that it does in the Southern United States. The fields are never large, and picking is done at the leisure and convenience of the planters. The pickers carry baskets or bags with them, in which to place the cotton as it is gathered, much as the work is done in this country.



A CORNER IN THE MERRIMACK MILLS, LOWELL.



OLD-TIME SPINNING WHEEL.

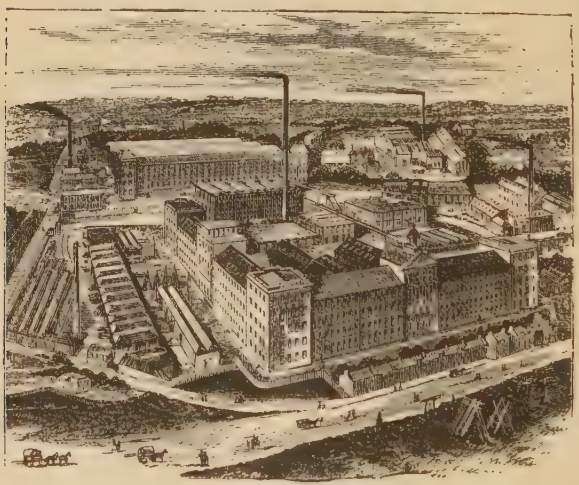
COTTON INDUSTRIES.

What an expanse of knowledge opens up in the one word cotton! We read of thousands of millions of pounds brought to the mills, made into cloth, and sent out again. We call it one of the staple industries of our country.

Cotton is made into thread, ropes and cloth; chiefly into cloth. Cotton ropes are not very good because they stretch and shrink too easily. Cotton batting is used for stuffing mattresses and cushions.

Formerly our great-grandmothers did their own spinning and weaving, at their own firesides, by means of a spinning-wheel and a rude kind of loom, and using generally for their cloth, the flax grown in their own gardens, or the wool produced by their sheep. At the present time in our country and in England the cloths are made in looms that are run by

machinery, but in India cotton-cloth is still often woven in hand-looms. A man frequently spends several months in weaving a single piece. Such cloth is very beautiful, and it is sometimes so fine that, when on the grass and covered with dew, it cannot be seen. Some cloths made in Decca are called "woven wind," they are so delicate.



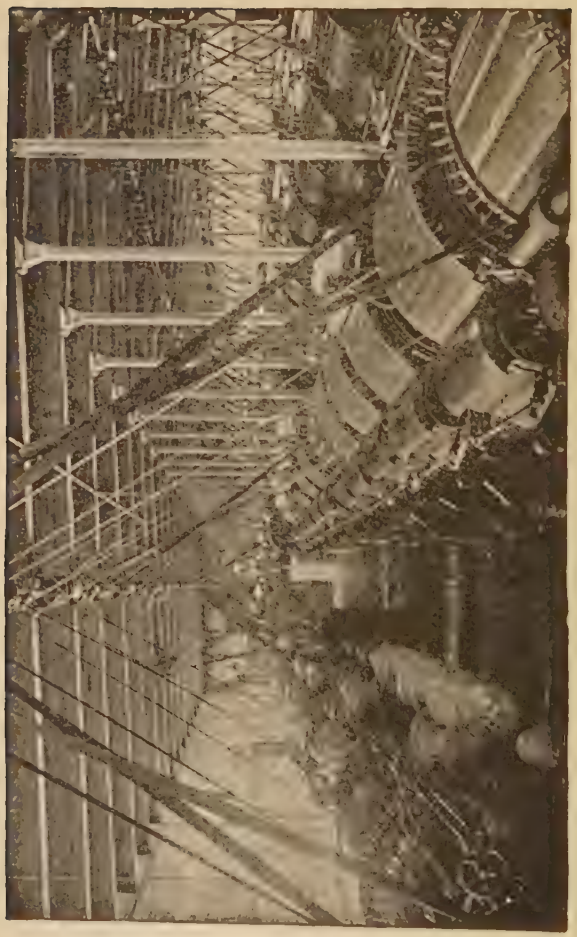
COTTON MILLS.

Here is a cotton mill. Massive, lofty and grand are the piles of building with their still loftier chimney-shafts and their myriad windows. Here are bales of raw cotton packed close to fill large store-rooms. Here are floors full of machines in motion doing their work as though they could think and reason. Here

again are bales, this time of finished cloths. Take a large, hard flake of cotton out of the bale as you would a handful of hay out of a farmer's rack. It is full of seeds, lumps, and bits of stick and dirt, and matted like an Indian's hair. A "blown," which blows with the roar of a blast-furnace, nibbles at it and it is

DOMESTIC SPINNING IN THE OLDEN TIME.

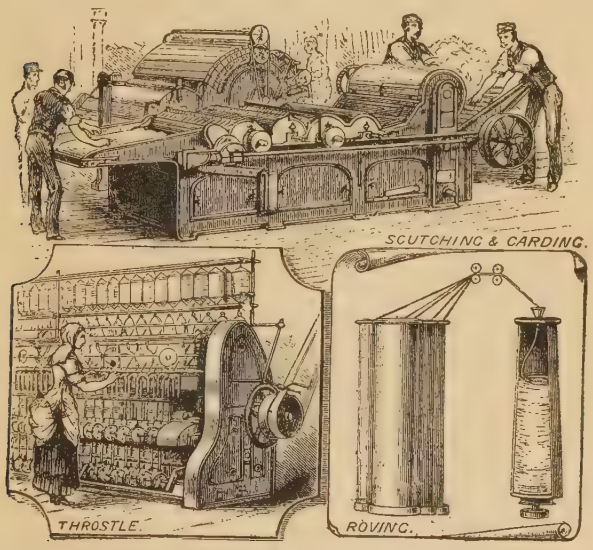
gone. One blowing puffs out the seeds and cleans the cotton, and it comes back to you as fleecy as swans-down. Inside the blower there is a beater of steel which turns many times in a second, while a fan below revolves as fast. The beater thrashes and the fan winnows the fibres. The dust and refuse fall through chinks to the bottom, while a snowstorm, with flakes



VIEW IN A CARDING ROOM.

as large as the palm of the hand, of pure white puffy cotton-wool, drives onward.

All day long cotton comes down through shafts in the roof above, fed by the boy in charge, to be bitten to pieces in the blower, until one would think that the ratchet teeth of the machine would ache. The



MODERN MACHINES—SCUTCHING AND CARDING.

snowy cloud leaves the blower or "scutcher" in a moving white bed, like a broad, frothy stream of new milk.

The beating and blowing are gone through, over and over again, and, at every stage, render the cotton whiter and purer, till, after its sixth or seventh

thrashing and fanning, it bubbles out at last a silent, beautiful, soft, downy river of *liquid* cotton-wool, which cosily snugs itself round a giant reel, in laps, like a roll of carpet.

These laps are hurried off to the cards or combs, in a great room crowded with a hundred carding engines: all are moving and all are doing the same kind of work. The main part of these engines consists of combs, made of stout leather, set with steel wire teeth, finer, shorter, and closer set than the bristles of a clothes brush; these combs are wound around drums, some as large as a garden roller, others smaller. The teeth of these drums play into each other as they revolve opposite ways and each, in turn, takes the lap of cotton from the other. From card to card the cotton goes and is allowed no rest till, when it leaves the last combing, every fibre lies straight and even as pins in their paper; or as does your hair when it is nicely brushed.

Cotton fibres, though thinner than cobwebs singly, are yet tubes. In their growth on the seed, they become twisted or spiral, a great help in carding; for just as corkscrews twine together and point all one way after a good shake, so do the filaments of cotton after carding. Fast, but gently, there is sent off at last a thin, filmy cloud of gossamer, floating in the air, which gathers into an endless curl

or sliver of pearly-white cotton. Light as a wreath of smoke the sliver goes on to unite with its fellow-slivers, and with them winds at length in a flat coil upon a metal reel.

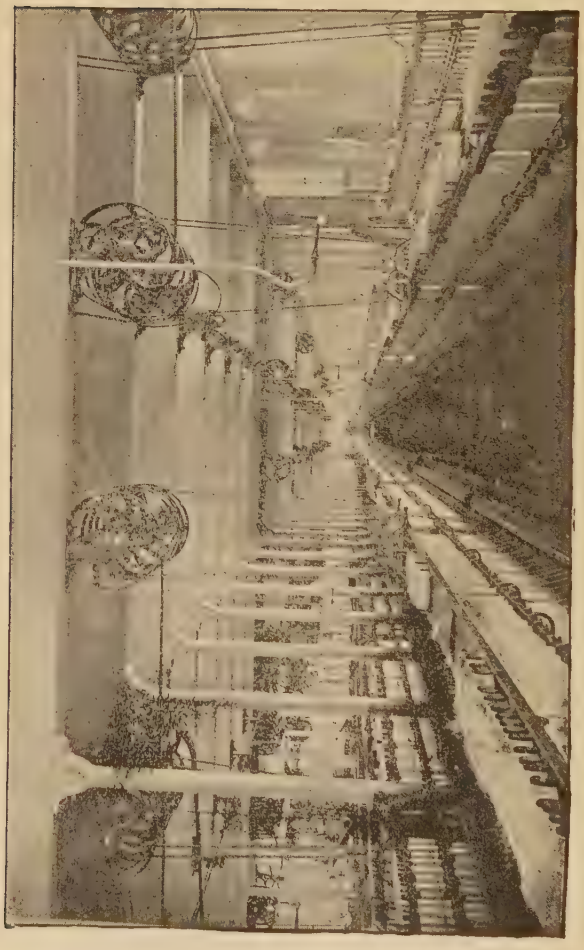
From the cards the slivers travel to the drawing machines, and now we see why so many slivers are joined in one. The filaments of cotton are not all equal, and some of them break in carding, which would make bad thread. When the slivers are doubled, over and over again, and when these doubled slivers, drawn out to the size of a candle-wick, are doubled from sixteen to twenty thousand times, the stouter threads correct the weak ones. The finer the thread, the greater the number of card-ends doubled into one. For fine lace sixty thousand or more are thus doubled and drawn out into a single delicate thread.

Now the slivers are twisted and wound upon bobbins. Now to the throstle or spinning frame.

Seated on the bars of the throstle are long lines of reels of cotton thread looking like a row of white breasts of sea-birds.

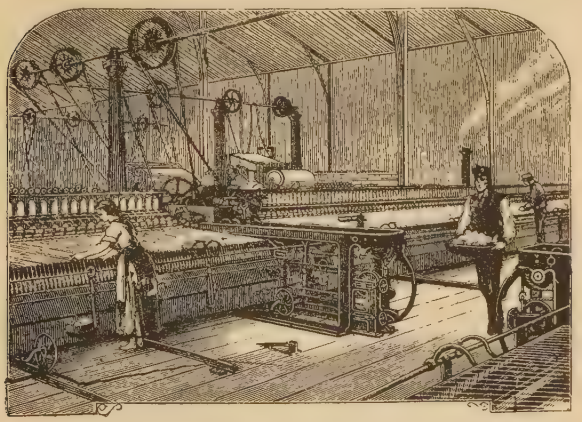
Round and round go the bobbins. Reels at the top give out the thread which is drawn finer and twisted, and bobbins below receive it until they are filled and others take their place.

Up to the next floor, and we are in the midst of the spinning proper. Here the spinner takes charge of



VIEW IN A RING SPINNING ROOM.

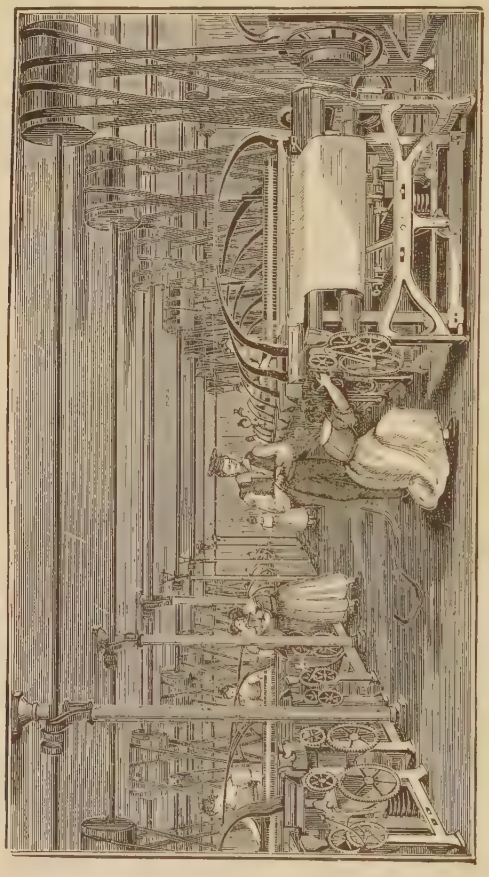
generally two or more great frames called mule-frames, which move backward and forward. The spinner must "look sharp" indeed; he has no time to idle and gossip; a thread breaks. In a twinkling, with a touch and a twist only a spinner knows, it is mended. The room is kept warm to prevent breakage.



SPINNING MULE.

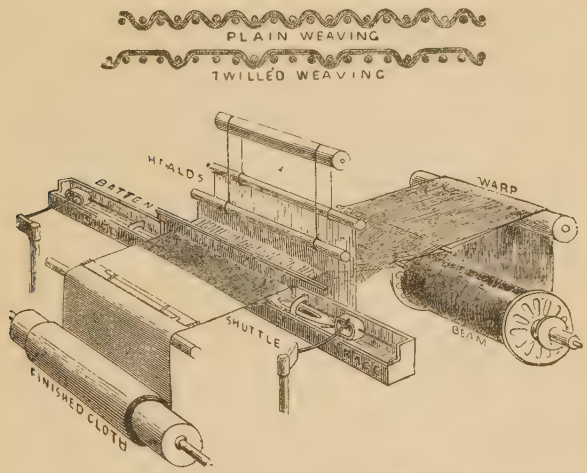
The mule frames move forward and draw out the thread, then back they glide, and a thousand little spindles begin their whirling dance and wind evenly the thread fine and perfect at last.

Floor above floor, and still the swirl of spindles. A mood comes over us to believe anything about cotton. For the time we feel as though life was a thread and the world one tremendous ball of cotton.



POWER LOOM WEAVING EARLY IN THE CENTURY.

Sewing-cotton and cotton thread, to the finest threads for lace, are the sole work of many great mills, where engines and frames are closely packed and busy. Others are filled with looms and warping frames, etc., for the manufacture of cloth. The contrast is wonderful between the huge factories, the fierce steam-



PRINCIPLE OF POWER-LOOM.

engines, the many machines, the thousands of workers, and the little ball of cotton for which they are all brought together.

If you unravel a piece of calico you will see that the threads cross each other, twining in and out, over and under, close alongside, in the length and breadth of the cloth. The art of crossing the loose and sep-

arate threads, so as to combine them into a firm compact sheet of cloth, is called weaving. Clothes to wear have always been one of the first of our vital needs, and weavers must have been at work long before men had learned to read and write, or leave any record of their labor.

POWER-LOOM ROOM.

A good deal has to be done with the thread before it gets to the loom. As a rule, the twist, to form the *warp* or length-thread of the cloth, is throstle-spun, while the *weft*, or breadth-thread, which *wafts* two and fro with the shuttle, is spun upon the mule-frames. Women prepare the warp for the loom. The warping

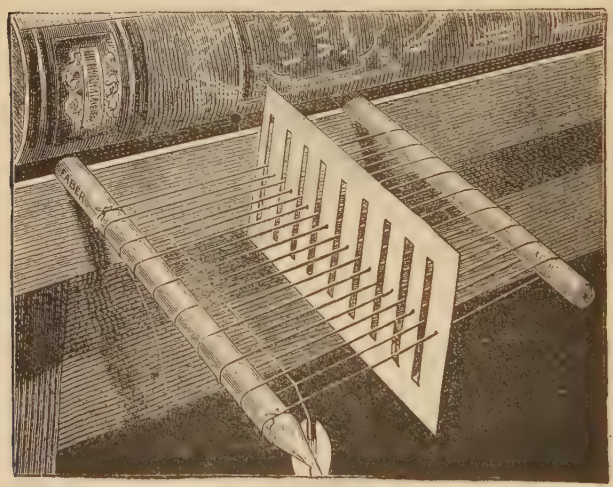
frames look not unlike giant clothes-horses, on the bars of which are placed bobbins without number. From all these bobbins the ends are culled and drawn, narrower and narrower, to a roller, just the width of the cloth to be woven. They pass on their way through slip gauges, to keep their exact distance apart; and, round the roller they wind, a sheet of cloth without the cross thread or weft. And now the long lines of thread look as though the giants might be having a tremendous game of "cradle."

The action of the loom upon the warp is to raise one set of alternate threads and to lower the other set, so as to divide the warp into two sheets of thread. It is trying labor; every separate thread must be seen to, so that all shall rise and fall without a mistake, and at the same time travel on toward the shuttle.

The roll of woven cloth lengthens and lengthens as the shuttle flies to and fro, with the rap it gets on either side. Neither end will have it. Self-acting arms fling it backwards and forwards, as if in spite, and do not cease till the cob is wound out.

Between the two separated layers of warp threads the weaver puts in, with shuttles, the weft threads across the warp at right angles, and fills up the breadth of the web. By means of treadles both warp and weft threads are beaten up; that is, pushed up together, so as to make the cloth firm and compact.

But we want to know a little more about the principle of the loom. When these machines are in motion, we can only look on and admire the ingenious mechanism that causes them to act, but it is hard at first to understand the fundamental principle that makes them work.

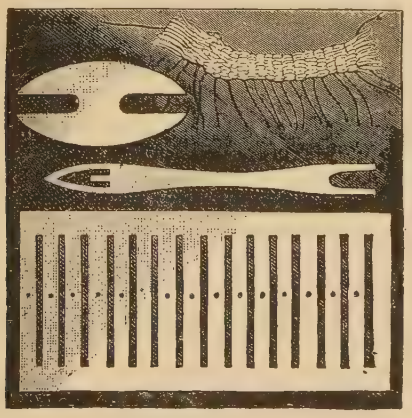


If we take two lead pencils, a visiting card, a wooden paper cutter, some thread and a pen-knife, we can manufacture a loom, ourselves, and see the method of working.

The two pencils serve as warp beams, and we can cut a "heddle," as the frame is called which holds the threads on their way to the loom, out of the card with the pen-knife.

We can also cut one or two shuttles out of the same card, for winding the weft that is to go through the threads of the chain.

We place the pencils on the edge of the table, with a heavy book to hold them in position, as shown in the picture, and then begin warping.



SHUTTLES AND HEDDLE MADE OF CARDBOARD.

This is done by attaching one end of the chain to one of the pencils, and threading a large needle with the other end, pass it through the first slit in the heddle, then wind it once round the other pencil and through the first opening again, then around the first pencil, then pass it through the second opening in the card, and so on until the last slit is reached.

After this, in order to weave, it is only necessary to raise and lower the heddle alternately, and, as may be easily seen, the only threads carried along are those that run through the openings. At each of these motions the shuttle must be passed between the two series of warp threads situated at different levels. A paper cutter may be used instead of a batten to push the weft home to the web.

This little device may be quickly and easily constructed, and from it the mechanism of weaving may be perfectly understood, combining amusement and instruction.

In New England the rise of cotton manufacturing was slow and gradual, and for this reason no one town can claim the distinction of being its birthplace. Beverly, Mass., however, is generally spoken of as having been the seat of the first cotton factory in America.

It was Tench Coxe, a prominent resident of Philadelphia, who first urged the cultivation of cotton in the South, at a time when the plant was scarcely seen outside a flower garden, and he was very active in organizing a company for its manufacture.

This was somewhere about the year 1775, and

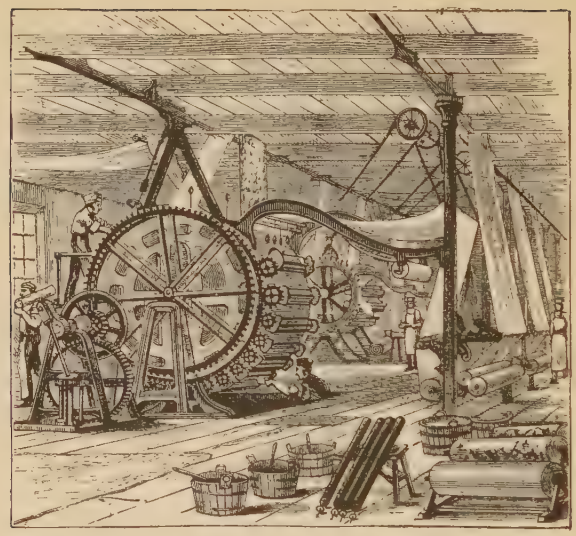
great difficulties had to be contended with in constructing proper machinery for the different processes. So it was slow work up to the end of the century.

About that time, a young man named Slater arrived in this country from England, where he had been connected with the cotton industry, and had mastered the details of the best machinery then in use. He succeeded in producing a card and spinning machine, which greatly facilitated matters, and in 1793, the firm of which young Slater had become a partner built a small mill at Pawtucket, which still stands, and is known as the "old factory."

After the spinning system was once established, the extension of the cotton trade became rapid.

In the year 1850, there were nearly 1100 factories in the United States, consuming about 290,000,000 pounds of cotton.

In 1890, the number of spindles in operation was estimated at about 14,000,000. In the Southern States there are nearly 2,000,000 spindles at work.



CALICO PRINTERS.

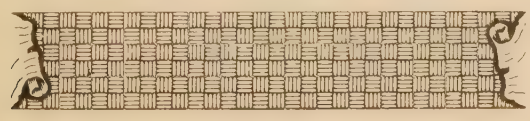
CALICO PRINTING.

THE name Calico was derived from Calicut, on the Malabar coast, whence printed goods were first imported. The dyes and colors used in printing calico are of two kinds, those which penetrate through the cloth and show almost as brightly on one side as on the other, and those which are intended to be seen only on one side; great pains have to be taken to make "fast colors."

The color house at the print-works is an important place and the workers there must have a knowledge of chemistry. There are to be seen mills and stones for grinding; rotating machines for mixing, and caldrons and boilers for heating.

Some of the colors must be thickened with starch, or flour, or gum, to make them more like paint than dye; some, in order to be "fast-colors," must be mixed with mordant; some must be thinned with liquid, and some must be acted upon by steam after they have been applied to the cloth.

The pattern for that dainty print in your apron was engraved on a roller or cylinder of brass. The roller was coated with varnish and the pattern scratched in the varnish with a fine point. Nitric acid was spread on, which ate into the metal where the scratches had been made, thus engraving the drawing upon the roller. There were just as many separate cells of dye-stuffs attached to the rollers as there are different colors in your apron, and just as many rollers as colors. When all were ready the wonderful machinery began to turn, each roller and cell of color acting at its appointed time. So perfect were all the adjustments that *one mile of calico was printed in one hour.*



LINEN.

"I CAN boast an older ancestry than can you, Cotton," said a bit of Linen to his neighbor and companion in the work-basket one day.

"Can you?" said Cotton, good-naturedly.

"Yes," said Linen, "whether the Egyptians first thought of linen making, or whether they learned it of some race older than themselves, I have never been able to find out; but I know they made it so

long ago, that in many of their most ancient tombs are pictures of people pulling flax and spinning and weaving it. Their mummies, too, are found wrapped in bandages of linen as fine, firm and nicely finished as any people of these times can make."

"Tell me more about yourself," said Cotton, growing interested. "Were you woven as I was?"

"In much the same way," said Linen; "but I will go back to the beginning.

"When the bright little blossoms of the flax plants had fallen off, and their seed-vessels had begun to change from a green to a pale brown color, and when their stalks had began to grow yellow, the plants were pulled up, roots and all.

"The pulling was done on dry days, when the sun shone warm and bright. As fast as the stalks were pulled they were made up into sheaves with all the stalks laid parallel and all the root-ends even and were left to dry in the sun awhile.

"Then the men came again, spread a great cloth down in the field, and in the centre of the cloth placed a machine which looked like a great iron comb held up by a wooden frame.

"Two of the men sat beside this comb and drew our stalks between the great iron teeth; so carefully did they do this that even the delicate fibres at the upper part of our stems were not broken nor injured."

"I see!" said Cotton, all attention; "this was to separate the seeds from the stalks."

"Yes," said Linen, "the seeds were sent away to market and all the stalks were tied up in small bundles and placed in soft water. Sometimes the bundles are placed in dams near the field where the flax-plants grew, but we were put into vats of water under cover.

"There we had to stay in the wet and damp, till our fibres began to separate from the woody cores of our stalks. In this condition we were gathered up again and stacked for a while to dry. Then we were carried away to the *scutching mill*.

"It makes me groan even now to think what we endured in that terrible scutching machine! You see the first thing necessary was to get our fibres free from the woody cores of our stalks, and so make the fibres fit for market. We were pushed between grooved rollers till our cores were broken into fragments; then we were hung up in the scutching machine, which was fitted up with revolving flat arms or blades of metal: round and round those blades would fly, and strike angrily against us at every turn, till the bruised and broken bits of our cores all dropped away from among our fibres.

"But this was over at last and our fibres made up into bundles for market.

"Arrived at the linen mills, we went first to a man

who separated our bundles into small parcels, and combed us with another comb, or hackle, with iron teeth; this pulled us out straight. Some of our fibres came safely through, without being broken; these longer, better fibres we heard him call 'longs,' the pieces broken off and clinging to the roots around the pins of the hackle, he called 'shorts.'

"From this combing we went to a *hackling-machine*, which split our fibres into finer ones, from this machine we were drawn to another finer one and then to another one, still finer, to be cleansed. After passing through all this, we were considered 'dressed' and were passed along to a sorting table, where we were placed with other fibres of exactly the same quality. You remember the 'carding engine' friend Cotton?" said Linen.

"I rather think I shall not soon forget it," said Cotton.

"Well," said Linen, "the 'spreading frame' to which we were next taken was much like it. A girl placed us upon the revolving sheets of this machine, taking great pains to lay us all even and exactly parallel. She was careful, too, I noticed, not to put too many of us in at one time, lest when we passed out in a ribbon-like strip at the other end of the machine the strip or 'sliver' as she called it, should be too thick.

"I told you we were placed upon the revolving

sheets; these whirled us along to rollers which we passed through; next we whirled over brass guide-plates and into pressing-rollers till those of us who were placed first upon the sheets of the machine began to be drawn out into a strip or 'sliver.'

"They had an odd way of measuring us, we thought. The sliver or strip passed into long cylinder-shaped cans, called 'sliver-cans.' Upon the end of the rollers which carried us into the can was a wheel which, when it had turned round once, rang a *little bell*. In this way the attendant knew just how much had been put into the can; when just enough had been put in he carried it away and put an empty one in its place.

"We went next to a drawing-frame where we were drawn out of the cans, doubled and drawn into one length. Next we went to a 'roving-frame' where we were twisted a little and wound upon bobbins as you were. We were ready for spinning at last.

"We were spun very much as you were throstle-spun, friend Cotton; but our fibres did not cling together as readily as yours did, so we had to be moistened with warm water.

"The warm water was placed in a trough which stretched along the whole length of the spinning-frame. It was fun to see the spindle turning rapidly

about in the water and throwing a fine dewy spray all over us and the attendants, who, by the way, had to wear great water-proof aprons, or their clothing would have been wet through in a short time.

"The spinning-machine drew us out finer, twisted us again and wound us, in the form of yarn, upon reels.

"We thought we were surely ready for weaving then, but no; we were boiled and boiled, and washed and rinsed unmercifully for a long time.

"Some of us were bleached for white goods, some of us were dyed for colored goods.

"But we were finally woven in just the same way as your threads were woven into cloth, friend Cotton."

"I am glad we met here," said Cotton, "for I have learned two lessons; one of the weaving of linen, and another, that some one beside myself has passed through a great many trials."

FLAX PLANT.

WOOL-BEARING ANIMALS.

WOOLENS.

YOU will not wonder that your soft wool dress costs so much more than a print when you have learned how much labor it required before it could lie in those soft, glossy, richly-colored folds.

Every bag or bale of wool — containing from one hundred to one hundred and fifty pounds — brought to the factories from the sheep farms, contains fibres good, bad, and indifferent jumbled and matted together. These wool fibres are first laid out on long tables and carefully "picked over" or sorted.

The sorted wool is foul with fat and dirt, so into great boilers of hot alkaline liquor it must go, where

it has the oddest habit of moving about and rolling over and over as if it longed to get itself clean. The clouds of rising steam are blended with putrid animal odors. Just over the boiler is a grating made of cross bars of wood; it is a drainer, and upon it the

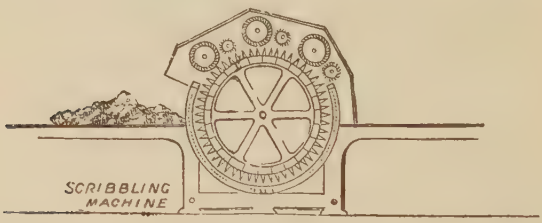
SORTING AND SCOURING.

wool, looking like greenish slime, is laid when taken from the boiler. Next the wool is treated to a cold bath, dashed to and fro for a while in the water without mercy, and hooked up finally with a fork into a mound of clean soft wool. Next the wool is "fed" to

a machine having a wooden roller studded thick with iron spikes. The revolving spikes tear the fibres apart, making them easier to work, and shaking out dirt and dust from between them.

A few yards further on women are picking the fleece in pieces, to rid it of any stray bits of straw or wood that may have been left clinging to it and would hurt the cloth. Baskets are at their sides piled high with the white fleece.

The wool, by this time nearly freed from impurities,

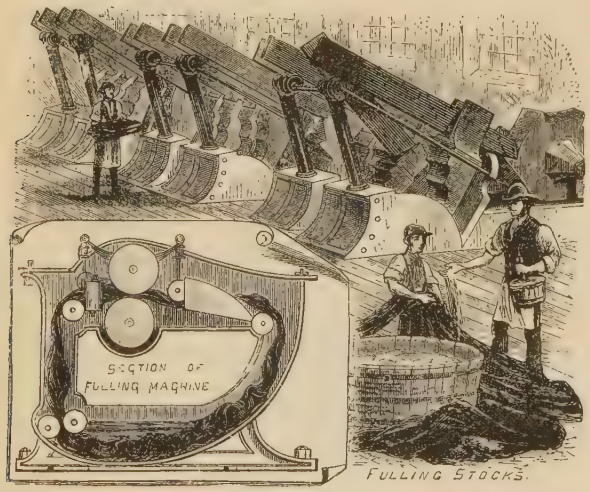


is spread out in a thick layer on a stone floor and sprinkled with oil. It is passed a second time through the machine with the spiked rollers to mix the oil with the fibres.

The scribbling machine changes the oiled wool into a broad, thin, flat fleece, or lap, with the fibres open or separated.

The carding engine, with comb-teeth and revolving cylinders, brings the wool to the form of slivers a few feet long and then into *rovings* looking like short pieces of soft cord. These *rovings* of wool are put

into a machine having spindles, rollers, wheels and a movable frame, where they are joined end to end, stretched and slightly twisted. The wool is then spun and spooled in much the same way as was the cotton, and after sizing and beaming, is ready for weaving. The weaving process varies, of course, according to



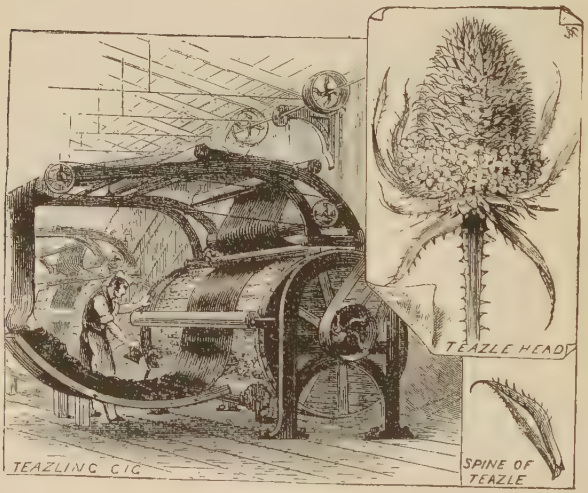
FULLING.

whether the cloth is to be single, double, twilled, mapped or ribbed.

Next comes a process called *Fulling*. You know how blankets and stockings thicken up and grow smaller if washed in hot water. This is because the fibres of the wool are "crinkly" and draw themselves

up into closer "crimps" when the hot water touches them. The manufacturers take advantage of this to make the cloth thick and strong.

The cloth to be fulled is well soaked with soap and hot water, and pressed and rubbed between machine-rollers. In the making of broadcloth the fibres are



TEAZELS.

"milled" or "fulled" so much that they become matted together. All cloth taken from the fulling machine must be stretched by hooks on a frame, else it would dry unevenly and be wrinkled and curled.

The wiry sharp fine hooks or awns, of the thistle-heads, known as teazels, which are imported from

France, are used to raise up the fibres of wool, or teaze the surface of the cloth exposed to their action, into a velvety pile, or nap, just as the harrow works in spring.

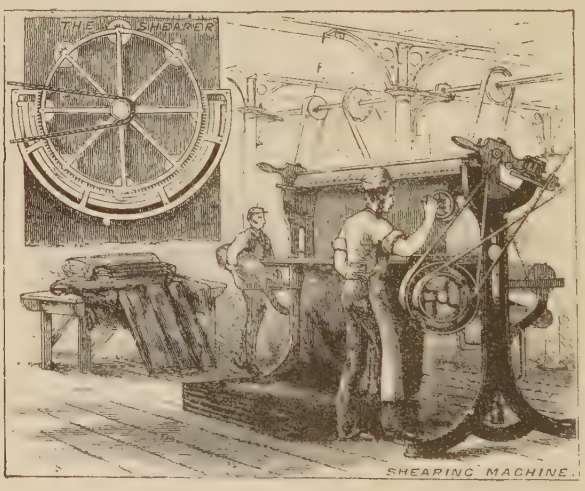
There are two varieties of teazels, the wild and the cultivated, growing to the height of four or five feet. The wild kind is of no service, as the awns are weak and easily broken. In the cultivated teazel, the awns are closer set and of a stronger texture. The head of the teazel is covered with awns, curving back towards the stem like the teeth of a shark.

The tiny seed-grains of teazels, borne aloft by a downy parachute, float on the wind for miles and settle in the farmer's crops, where they are more free than welcome. Farmers hold them in horror, and carry a narrow, chisel-edged thistle-spud to cut them down. Teazels befriend the cloth-workers, who would be at a standstill without them. They are grown as a field crop in England and exhaust the soil more than most crops. Many farmers hesitate to grow teazels, as their yield is very uncertain; the harvest failing from blight and bad seasons. When ripe, the heads are cut off with about six inches of stem, and they are bunched in a split stick as you bunch cowslips in spring time. The bunches, containing three or four hundred heads, are tied into "packs" to be sold.

Boys, in the factories, fix the teazel heads in a small

rack or frame, holding thirty or forty heads, and called a handle. The stalks peeping through are shaven off close and the teazel rack is ready for duty.

These simple thistles are more durable than any one would imagine; the wet elastic awns, if bent, leap back into position when dried, so they can be used many times over.



SHEARING CLOTH.

The number of teazels used in a year is immense. Heavily-laden wagons of them are constant visitors at the mills.

The handles are fixed round a wooden cylinder, which the cloth passes quickly over, while a jet of water plays upon it that the teazels may have a moist surface to work upon.

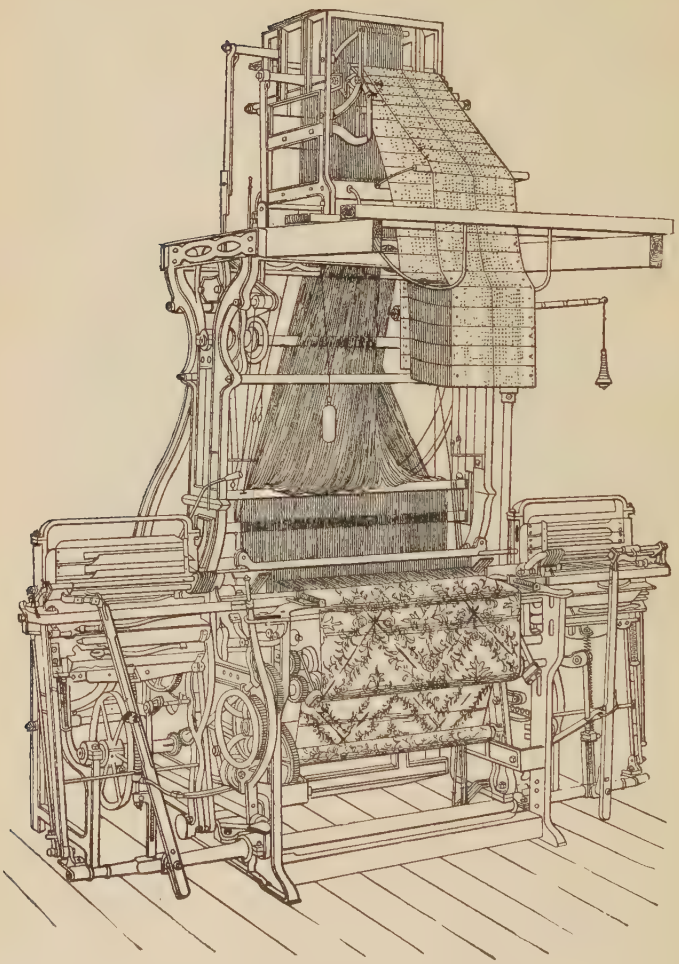
After this, the cloth passes through the cutting-machine or shearing engine, which shears the nap off close, leaving a smooth face to the cloth. The shears act on the same principle as our lawn mowers. The cutting part consists of a roller, round which wind spiral, sharp edges which, while revolving, meet, in turn, a fixed, straight blade, and act as a succession of scissors. The cloth, hooked across its breadth with

WOOL DYEING.

half a dozen hooks, passes under the cutting blade, and comes out as clean as a fresh-shaved chin.

For a whole day it is "squeezed," to take out the creases, bring the bulk down, and leave the cloth ready for finishing. The heavy pressure gives a smoothness and glossiness. This is aided by *boiling*, steaming and brushing.

Some cloths are dyed in the piece; others are wool dyed, that is, the wool is dyed before it is woven.



CARPET WEAVING.

CARPETS.

E are sure you will look with a new interest at the bright carpet which adorns your sitting-room floor, when you have learned that it, too, was a present from the sheep.

Persia has always had the fame of manufacturing the most beautiful and durable carpets; and next to that country, the carpets of India and Turkey are most esteemed.

Carpets of all grades and patterns are turned out yearly from our own busy looms.

In old times carpets had to be woven in hand-looms, but different machine-looms have been invented until, in these days, we have a different machine for every different kind of carpet.

Those pretty figures would have had to be put in with great labor in old times and would have made your carpet very expensive. Now such figures can be woven by machinery with very little trouble.

The "Scotch" or Kidderminster carpet is woven with a worsted warp, and a cotton or woolen weft, and is woven in pieces about a yard wide. Two colors are generally woven into this kind of carpet, and it is made in two webs woven together.

Does your carpet have a gold figure on a maroon

ground? If so, one web was gold, the other maroon, and each passed over the other at certain fixed points. Look at the wrong side and you will see that just where it is gold on one side it is maroon on the other.

In the Brussels carpets can be woven many different colors. Each color has its layer of thread, running from end to end of the web. So skillfully does the machine do its work that it almost seems as though each of these colors knows when its turn comes to show its bright face on the surface, and when to sink down out of sight again.

The figures are raised by wires passing between the linen foundation and the bright worsteds. These wires are afterward taken out and leave a looped surface.

Wilton carpets are woven in the same way, except that the worsted loops are cut open, so forming a velvety pile.

In tapestry carpets a pile is made as in Brussels, but only a single thread is used in texture, instead of the five or six which are run through the Brussels. In the tapestry the threads are colored before they are woven. One thread, or two treated as one, in some cases a mile in length, is colored as it passes along faster than you could run if you did your best.

Supposing a rosebud must be made a thousand times in the length of the web at intervals of four feet; a thread, just the length of the web, is wound

round a hollow cylinder and a wheel, filled with the right color, is passed around the worsted coil. The thread, when uncoiled, will be found to be marked in a thousand places just where it is wanted to tip the bud with red from end to end of the web.

Design paper, upon which the design is indicated in small squares, serves as a guide to the colorer, for one square means just one stroke of the color-pulley. After the threads are streaked they are removed and the dyes are fixed by steam.

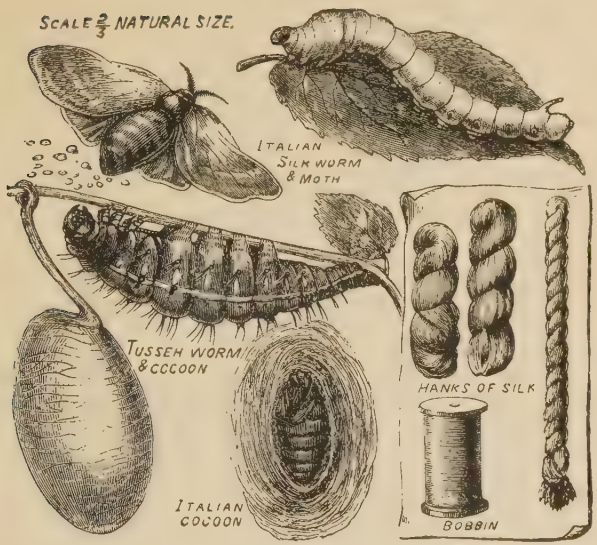
The cards you see at the top of the machine in the picture on page 42 are perforated to produce the design. These cards are upon a cylinder. When the weaving commences the card cylinder begins to revolve, bringing up the cards on the inside of the frame.

Every time the cylinder moves it makes only one-fourth of a revolution, and brings up a fresh card. The cards lie evenly on the flat surface of the cylinder and are brought, one by one, against the needle-board — the arrangement above the cards.

When the needles enter the holes in the cards a bar descends, catches hold of these hooks and, rising again, draws them upward. As they are lifted, an opening is made for the shuttle to pass through with the crosswise threads.

Rugs, table covers, velvets and tapestry hangings are manufactured in the same way.

MOTH, WORM AND COCOON.



SILK CULTURE.

SILK dresses were worn in China and Japan long before they were known in other parts of the world. The Chinese kept the origin of the silk a profound secret. It was long thought to be a plant fibre, like flax and cotton. No one could believe that such a bright, rich, soft substance was the product of a little caterpillar. The secret was found out by some travelers in China, who hid a few of the eggs in a hollow bam-

boo cane which they brought home. How little idea they must have had that these eggs would prove to be the beginning of the silk culture, which now finds a livelihood for thousands of families. In spite of the fact that rulers of every country tried to thwart silk manufacture in any but their own land; in spite of disease which often attacked the worms, and the high price set upon the silk when woven into cloth, the silk culture grew and thrived. Silk manufacture in England began during the reign of Henry VI. But silk can only be profitable where laborers are many and labor cheap. China, Japan, Bengal, Piedmont, the Levant produce the most silk. The United States produce some silk.

The silk-worm spins from the outside, inwards, a loose cloudy web at first, and growing more and more compact toward the centre till the worm is, at last, quite hidden from view, like a kernel in a nut. There it stays in its golden crust which gives it the name of chrysalis, without food, till the moth appears to moisten the silk and make its way out. Only so many of the worms are allowed to develop into moths as are wanted to lay eggs for the next year's brood.

The best eggs only are used for rearing. The finest must be selected because eggs of an inferior moth will produce inferior worms, and the silk be of little

value. Soon after the moth steps out of the wrappings of her cocoon she begins to lay her eggs. During the next three or four days, she will lay *from four hundred to seven hundred eggs*.

The eggs do better and the worms produce the best silk in an even temperature, though silk-worms are raised in some parts of China in the open air. The

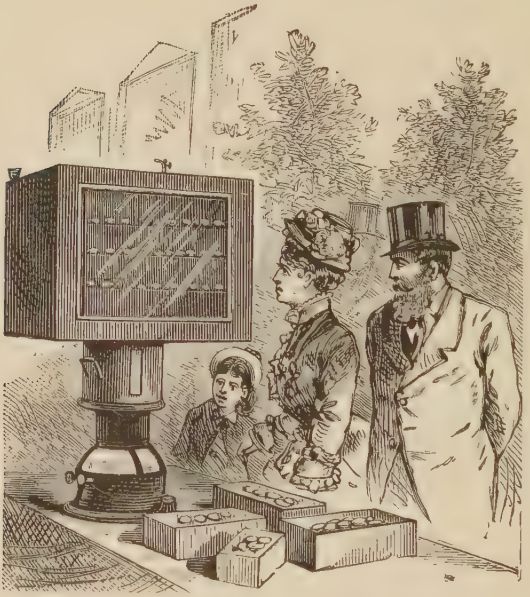
HATCHING TRAYS.

eggs are very small — about one hundred weighing a grain. A great number of the baby worms may be kept at first in a small space.

Pieces of paper, punctured with small holes, are placed over the trays where the hatching goes on. The worms, as they burst their shells, creep through the openings in the paper to the light, and so scrape

off any fragments of shell, which if left clinging to their skins would kill them in a short time.

The worms grow so fast — and no wonder, for they eat, eat all day long — that they soon are obliged to be allowed wider quarters. The leaves of the mul-



STIFLING THE MOTHS.

berry are cut from the trees, and while the worms are very small, are cut into bits and thrown in to the worms. The worms, from an ounce of eggs, will eat, in a month, *nearly a ton of leaves*.

These worms change their coats three or four times

within the month. At the end of that time they are quite "grown-up" and begin to creep up the brush-wood branches provided for them, and set about spinning their cocoons. In the course of three or four days the cocoons are made.

If the moth is allowed to come out of the cocoon it is likely to break the thread and so injure it. For this reason all the moths which are not kept for eggs must be killed before they awake as moths.

They are sometimes killed by baking the cocoons in an oven; sometimes by exposing them several days in the hot rays of the sun; sometimes by shutting the cocoons up in a close room where charcoal is burning.

Any method of killing the sleeping moths or chrysalides is called stifling. Unless great pains is taken the cocoons are likely to be injured in the stifling. The silk as spun by the worm is as fine as a cobweb.

COCOON.

REELING SILK.

SILK MANUFACTURE.

We must bear in mind the difference between reeled silk and the spun or waste silk manufactures. The reeled silk is wound off in fibres of great length, and for this reason, only the best cocoons are used in its manufacture. It is the injured and unreelable cocoons and the wastes from reeling which are treated by the spun-silk process.

For reeled silk-making the cocoons are sorted into classes having similar shades of color, size and quality in order to make the silk when reeled even and regular.

Italy and France use the following method: The

cocoons are taken to the reeling room, where they are floated in pans of water. The water must not be too cold, else the gum of the cocoons will not soften enough; nor too warm, lest the cocoons collapse and sink to the bottom. Girls, with sharp eyes and swift fingers, stir

SORTING AND REELING SILK.

the cocoons in the water till the silk softens and the end of the main thread or filament of each cocoon is found.

A number of these ends being brought together are passed through a pair of eyelets or guides, as you see

in the picture. The two sets or threads are then crossed or twisted around each other as if to make one thread, separated again and passed through separate guides to the reel. The object of crossing is to make the threads or filaments round and smooth. When these are dried they are found to have clung together and to form a compact single fibre of raw silk. Machines in modern times have been invented to do all this work.

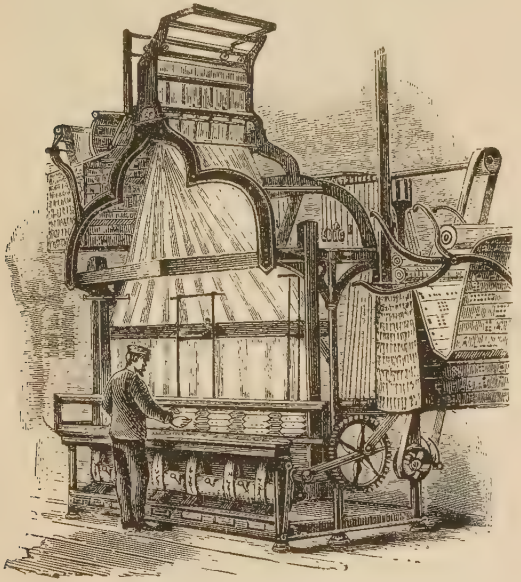
But the silk upon the reel is still too fine and delicate for use.

It is taken from the first reel and placed upon a second. From this it is wound upon bobbins in such a way as to lay the fibre in diagonal lines. These bobbins are taken to the spinning frame and there the strands receive their first twist. Next, the strands must be cleaned. They are simply reeled from one bobbin to another, but, on the way, pass through a slit only just wide enough for the thread.

Two or more threads are then wound together upon one reel and twisted into one yarn. From a machine with spindles and flyers the thread, stronger and thicker now, is reeled into hanks or skeins. You must know that silk in this state contains some water, and, as it is largely sold by weight this must be removed. So it is dried in a very hot place and immediately weighed.

Up to this point the silk has been stiff and harsh. Now the hanks are whirled about in soap and hot water, dried, packed in linen bags, boiled in water and at last allowed to dry in peace.

Whether the silk was white or yellow when this last



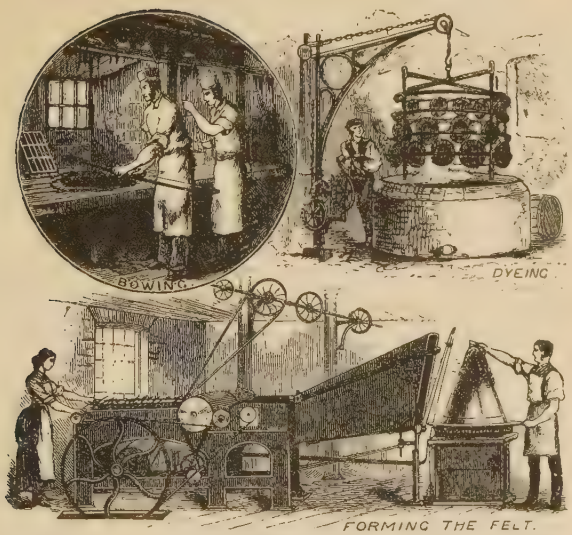
JACQUARD LOOM

cleaning process was begun, it comes out a brilliant white and is soft and flossy. It is then sent away to be colored and woven into beautiful ribbons and cloths.

In making spun silk the first thing is to bring the cocoon husks, waste, and poor cocoons together in one

mass. For this purpose they are put into a machine which whirls them round and pounds them in hot soapsuds; then into another full of cold water. Rinsing follows, then more beating, and by means of machines the whole mass is separated into strands about a foot long. They are spun together upon a wheel something as cotton is, and are made into a yarn called spun silk. Many silk stockings are made of spun silk, and, though they are not as glossy, they are much cheaper than those of reeled silk. Silk-worms can be raised in our country in either the North or the South; but the South and California are especially adapted to silk culture.

We have in our country more than two hundred silk mills, which manufacture more than $40,000,000 worth of cloths, ribbons, yarns, and threads every year. The proprietors of these mills have to send to China to buy the raw silk to make these goods with. Ten million dollars' worth of raw silk is imported annually. It would be much better to raise the silk we use than to pay some other country for raising it for us.



HATS.

LOOK at the heads of that crowd of people in the street! silk hats, felt hats, beaver hats, straw hats; each kind has a story of its own. Felt hats are of three different kinds; plain soft, plain hard, and napped or rough felt.

The finer, softer kinds are made almost wholly of fur; for the more common and harder kinds a mixture of fur and wool is used, and for the cheapest kinds wool alone.

It is only certain kinds of animal fibres that can be

felted, those which, when magnified, are seen to have a number of tiny projections from their surface all sloping toward the point of the fibre. The cat's fur has this quality; that is why it seems so rough and disagreeable when you stroke kitty the wrong way

BEAVERS AT HOME.

The hair of the rabbit, hare, musk-rat, and beaver have these jagged edges and are used more than any others in hat-making.

The long coarse hairs are taken out of the fur which is to be felted and the remainder cleansed, lest any grease should be left which would hinder the process of felting.

The fur, cut from the skin, is operated upon by a

blower, a machine with a fan inside which twirls around two thousand times a minute. The current of air which this fan makes separates the fur, according to its fineness and quality; for, you see, the coarse hairs with bits of stick, dirt and gravel, being heaviest, do not travel far, while the finest and lightest fibres are wafted away to the farther end of the machine in a pile by themselves.

Enough of the loosened fur to make a hat-body is weighed out and fed to a forming machine. When drawn in, it is caught by two rollers; one set with wire teeth and the other with lines of bristles, and revolving with the speed of 4000 turns a minute. From the outlet of the feeder, comes a light, drifting shower of short single fibres, which hurry and cling to a metal cone in front, as though drawn to a magnet.

Not a fibre escapes. They bind evenly round the cone from summit to base, while it slowly revolves, and an attendant turns upon it a fine spray of boiling water. We want to know the reason of the curious and pretty sight. We first find the copper cone to be set with fine holes closer than a sieve. We then see that it is placed over a kind of pit in which works a fan, drawing a current through the holes from the outside. The fan works very rapidly, driving out the air in the pit which the outer air rushes in to fill.

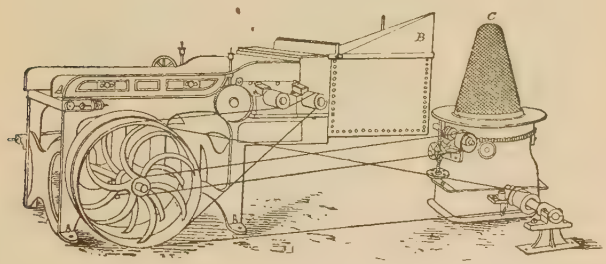
The felting, — a shrinking and pressing process — reduces the hat foundation to half its size and makes it thick and firm. It is now dried, and if it is intended for a hard felt hat is stiffened with a varnish of shellac.

FELTING.

The queer, conical shape is next softened and drawn over a hat-shaped wooden block. A string is passed round where the band is to be, and the brim is then flattened out from the string. Next it takes a dip in the dyeing liquid. Now, crown and brim are given just the right shape by being pulled over a second block of wood, and are smoothed by being scraped with emery or glass paper. The trimmer now

takes the hat in hand, binding the outer rim and putting in the lining; after this the brim is curled up or turned down according to the fashion.

Straw hats are made of the straws of wheat, rye, oats, barley and Indian corn, but those of the wheat are most suitable.



FORMING MACHINE.

The Tuscan straw which comes from Leghorn and its neighborhood is the best of all. The straws are sorted according to their length, colors and thickness. Some straws are plaited whole, others are split into four, six, or eight strips.

Great numbers of women and children used, at one time, to work at this in our country; but now nearly all our braid is imported. Straw hats and bonnets in our country are generally sewn by the straw-sewing machines on which one hundred hats can be made in one day.

FUR-BEARING ANIMALS.

FURS,

THE fur animals range through the wide plains which shelve down to the Polar Ocean and encircle its frozen waters. Since the settlement of Canada, the hunting grounds of America, under the control of the Hudson's Bay Company, outvie those of the Old World, under the government of Russia. Few people can live among the frozen bogs where the fur animals abound, and the lonely wastes are abandoned to the trappers and their precious prey. The creatures are mostly small, but fierce, with teeth

sharp and pointed like lancets, and a thirst for blood, never quenched, which they suck from their living victims. Their bodies are slender, long, and supple as snakes, to wind in and out the narrowest underground holes. It is a wonder how such cruel little beasts should be clothed in a delicate, beautiful, soft skin, and another wonder how they find food enough on such bare plains.

The beaver has nearly disappeared from the places where it once abounded. The timid animals cannot endure the presence of man, and forsake his haunts when hunted. In the sense of furs, as robes, the beaver-skin does not count.

The various kinds of furs brought to the market number several hundreds; the most costly of all being that of the sea-otter. Of the Russian furs, sables are most expensive, of which 25,000 a year are sold at Leipzig Fair, the chief mart of Russian furs. Another market for the Russian produce is Novgorod.

The fur next in value to the sable is that of the Russian ermine, a snow-white gliding creature, with the tip of its tail alone intensely black.

The workers in fur are called furriers. The term "work" is given to all fur goods. "Fine work" takes in the sable and ermine, the beaver, the otter, and the marten. "Common work" includes the skins of the wolf, fox, lynx, badger, bear and seal.

"Gray work" comprises the furs of the gray squirrel and of the domestic cat; "variegated work," those of the marmot and brown squirrel; and "spotted gray work," a mixture of these last two types.

When the furs are stripped from the animals the fat and flesh are carefully removed and the skins hung in a cool place to dry and harden; nothing is added to protect them. Care is taken that they do not heat after they are packed. They must be often aired and beaten, too, to keep out worms. The fur of the seal, however, is best preserved by packing them in hogsheads with plenty of salt. All other raw furs are baled for market.

Many such furs as those of rabbit and hare are dyed to imitate better ones, so that the poor as well as the rich may enjoy the warmth of fur Every kind of fur is of value and none is wasted.

Thousands of fingers are busy neatly joining together the small pieces to make tippits, boas and muffs, and trimmings which, when the work is done and the fur is smoothed all one way, would puzzle keen eyes to find the seam. The skins of sheep are sometimes prepared with the wool on, after the fashion of furs, and are dyed with bright colors for parlor and bedroom rugs.

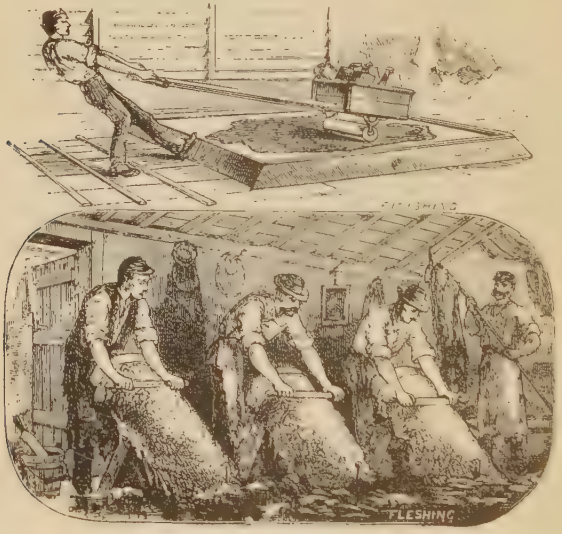
Trophies of the hunter's daring, in the shape of the skins of the royal and Bengal tigers, are sometimes used whole for mats.

HIDE MARKET.

LEATHER.

IF we follow the hides and skins as they come from the animals, we shall first see a large yard laid out in squares which make it look like a great checker board. This is the tannery; the squares are the "pits" filled with water and lime, with tannin made from hemlock bark. On the planks between the pits men are moving about, turning over the soaking hides with long rods; or changing them from one pit to another; or pumping up the dark fluid. Into these pits the

hides must go to be soaked for weeks; until they look like dark slime, which slips through the worker's clutch as easily as an eel through the fingers. Then they will be taken up tenderly and put upon frames to drain.



FLESHING THE HIDES.

Here they are in the beam-house among the "hairers" and "fleshers." Sloping and curved blocks, which rise as high as a man's chest, form "beams" over which the soft hides are stretched by the fleshers and hairers. The hairers keep up a tremendous "bowing and scraping" as they scrape the hair and outside skin away with their queer, curved knives with a handle at each end. The fleshers are

working with similar knives removing the fat and oily substances from the inside of the skins.

Some of the workmen are scraping and paring down hides as big as a carpet; others, "kips" or the small cowhides. In regular order, we may trace the sizes downward till we reach what looks like rabbit skins or the coat of poor puss.

The pig skin has a special value for saddles, as it makes such a strong fine-grained leather.

Fine morocco, for coach furniture and cabinet work, is made from the skin of the goats.

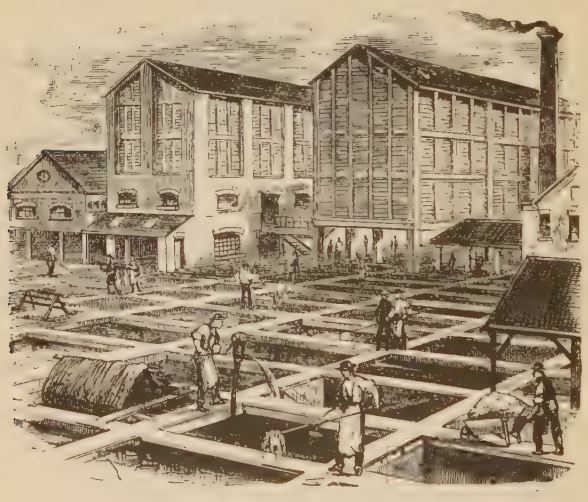
Every kind of skin from the most delicate to the toughest may be tanned into leather.

Shagreen, a leather produced from the skin of the sturgeon, finds a use as the covering for cases of drawing and surgical instruments. Alligator and crocodile skins make the strongest and most lasting pouches, purses, shoes,and slippers.

It takes years for the tannic acid to make leather of rhinoceros and elephant hides, but they come out, at last, thick, heavy, dense slabs resembling rough armor plates of India-rubber.

Now the skins are scraped clean of hair and flesh and all lime must be removed. More scraping with scudding knives and the skins are put into the dash-wheel which turns round and round, while the dark skins inside writhe about like living things.

Now we must follow the hides to the tan-yard again where the real tanning process begins. This time they are put into pits containing but very little tannin, but some acids and coloring matter. Here the hides are suspended over poles laid across the pit. Every day they are moved forward to a new pit and



TANNERY.

every new pit contains more tannin than the last. This is done to color the hides and remove the las traces of lime. Next they pass on to a new series of pits where they are "handled." This "handling" consists in laying the skins horizontally in the pits, lifting them out with iron hooks to drain a little and placing them in the next pit. As the hides are

moved on from pit to pit more tannin is added to the liquor. This takes about six weeks.

At the end of this time the hides are packed into the "lay away" pits like great sandwiches, with layers of tannin-bark between them.

These layers of bark are put in so that the liquor in the pit — very strong of tannin now — may have the better chance to soak into the hides, and at the same time supply the liquor with coloring matter as fast as the skins absorb it.

When, at length, the skins come out, looking very much like real leather, they are dried and pressed between rollers. "This does very well for sole-leather and the like," I hear you say, "but how did the uppers of my shoes come to be so glossy and black?"

Such leather as your boots are made of was stretched over a frame and tacked. Then a thick, syrupy liquid made of lamp-black and a varnish of umber, boiled linseed oil and litharge was spread all over it. This coating was dried in the air, then exposed to a great heat and afterward rubbed smooth with pumice-stones. The whole of this process was repeated again and again, and the leather was varnished once more.

Morocco leather is dyed. The dyeing house is quite an exhibition. Pans, tubs, and troughs bubble away, seemingly of their own accord. The attendant

has just let the steam on. We see no steam, no fire. The smooth surface of the dye, bubbles, then struggles and gurgles, then rages, and in five minutes becomes heated and colored.

An iron pipe from the steam engine dips into the

INTERIOR OF DYE-HOUSE.

dye and speedily raises it to a boiling point. Here is a trough looking as though its contents were a thick Black Sea, and as though demons were heaving it up with their struggles beneath the surface. Over there is a Red Sea bubbling away savagely; near at hand is

a restless Yellow Sea more turbid than that which laves the China coast.

The manufacture of wool mats is a branch work of some of the large tanneries.

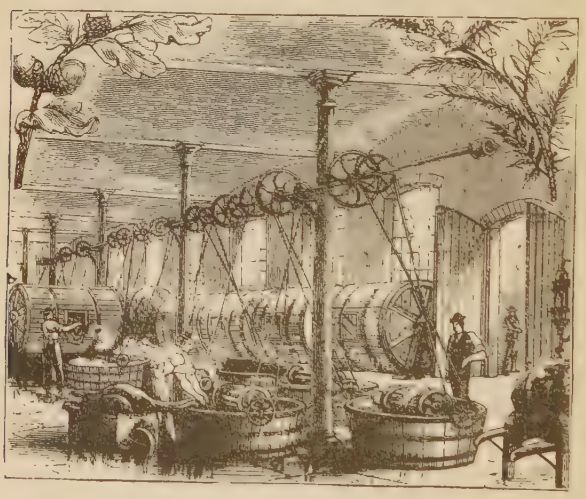
We notice a square lake in the open yard, where a strong fellow stands with a long pole in his hands. With this weapon he tosses, turns, and cleanses until he has beguiled out all the greasiness, and by scrubbing with soap has made them as white as snow.

TAWING SOFT LEATHER.

Another mode of preparing leather is called by the makers "tawing." Colored skins of all kinds are tanned; white are tawed. In tawing, the skins are made thick and tough, by steeping them in a solution of alum and salt. They are then cleansed of the alum and salt in a vat of bran and water. Dried afterwards in a lofty heated chamber, they become white and flexible, but harsh to the touch. Another soaking, and they are ready for changes, similar to those produced by the bark and the sumach.

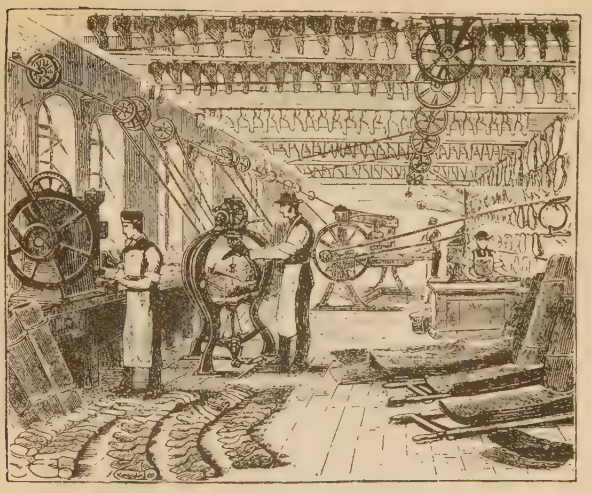
Again they are steeped, this time in the yolks of eggs diluted. The pores take in the egg and leave the water free. Millions of eggs are kept every year in brine till wanted, for the preparation of glove

leather alone. Tawed skins require little more beyond the attention of a few men to finish them off. You may see the operatives bending over long, peculiar knife-like tools, fixed upright in wooden blocks, and, while pressing the skins with the edge to hold them down, stretch them to double their first dimensions.



TAWING SOFT LEATHER.

Every moment we expect a slip and the knife to cut through, not merely the workman's *skin*, but through his ribs and body. Were you to change places with him it would do so soon, but, from long practice, he knows exactly the degree of force he may venture upon.

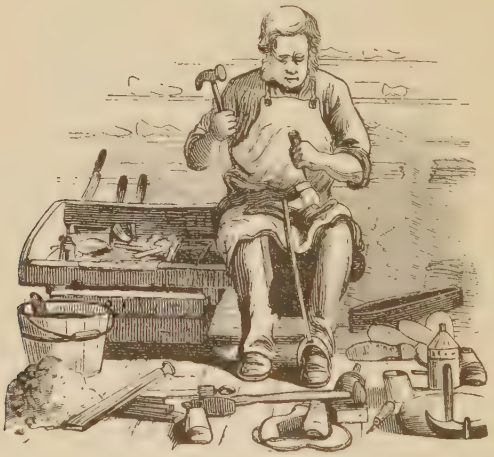


SHOE-MAKING BY MACHINERY.

SHOE-MAKING.

IF you could have taken a ride thirty years or so ago "over the roads" among the towns of eastern Massachusetts, you would have noticed that a small shop stood beside nearly every house. These tiny buildings were the shoe-maker's shops, where the shoe-maker's hammers and files kept up a busy clatter all day long, and where the neighboring farmers and their "hands" dropped in to lounge and gossip — for farmers *do* gossip as much as their wives — all the evening.

These little buildings have disappeared, with the exception of now and then one in some solitary spot, where it has grown black and moss-covered and leans to one side a little, as though dreaming of livelier times.



THE OLD-TIME SHOEMAKER.

For shoe-making has progressed and moved from these narrow quarters to the great factories of our cities.

The old-time shoe-maker had metal patterns of every size of shoe, and cut the leather for both "uppers" and soles by these patterns. The "uppers" were "closed," that is, sewed together, by strong, waxed threads, by the women of the house.

Ask grandma if she ever closed shoes upon a pair of "clamps," two savage-looking iron jaws set in a

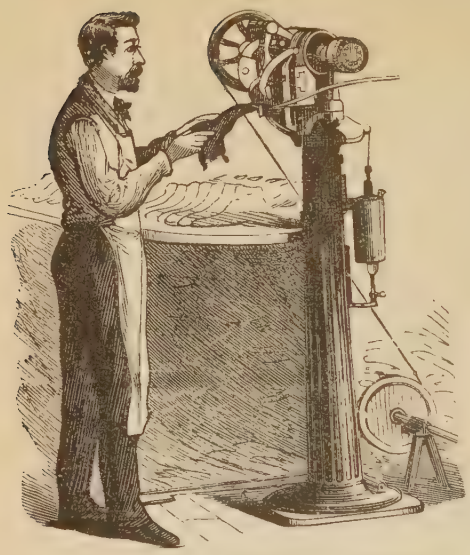
frame, and made to hold the pieces of leather firmly together while the sewer made rows of holes with an awl and drew the waxed threads firmly through. Ask her, too, if she never "bound" the tops of the shoes, as did Hannah of Lucy Larcom's poem, with the striped sheep-skin binding. When the shoes were "fitted" they were taken out to the "shop" again.

Here the shoe-maker tacked a thin inner sole to the bottom of a wooden block shaped exactly like a shoe. Then he put the "upper," all sewed nicely together now, over the block and tacked it firmly down upon the inner sole. Next, he tacked on with a few pegs the heavy outer sole, ran a sort of little wheel, not unlike the one you have seen mamma "rim" pies with, around the edge to mark the place for each peg and fell to work.

It was fun to watch him. He would take a mouthful of pegs, an awl in his left hand, a hammer in his right, and make a hole, snatch the peg from his mouth, set it up in the hole and whack it down into the leather and out of sight in such quick succession, you could hardly see what he was about.

When the sole had a neat, close row of pegs all the way around it, the pieces of leather for the heel were nailed on to the soled shoe.

Then there was a great time filing, scraping, and polishing the bottom of the sole, blacking the red

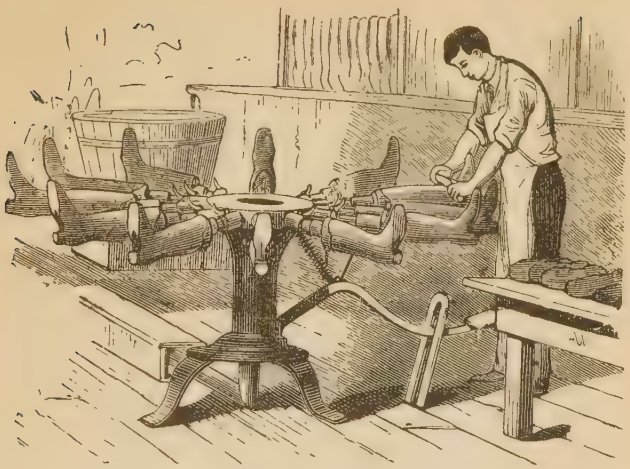


SEWING BY MACHINERY.

edge of the sole and rubbing it with black wax until it shone.

Some shoes were sewed instead of pegged, but today almost all shoes are sewed. Some are sewed wrong-side-out and turned!

Now-a-days all this cutting out, fitting, lasting, soling, heeling, and finishing is done by machinery. None of the workers make a whole shoe, but some stitch, others fold, others "last," others sole, others heel, and so on. There is not a single operation in shoe-making for which some machine has not been invented, and thousands of shoes are turned out at one time.



BOOT "TREEING."

HORSE HIDES.

THE horse, considering its size, has a thin skin. South America has long provided us, and continues to provide us, with hides both from the ox and horse. Our imports of these hides, partly from the wild, partly from the half-wild cattle, of that continent, are immense, counting by milions, and their repute is high.

The hide is worth more without the beast inside than with it. Anyway, the price paid by contract for tens of thousands of the hides, with the animal in them,

would make a butcher stare; for they have fetched hardly more than six cents apiece. Then they have to be hunted, caught, slaughtered, prepared, shipped, tanned and made into boots. The labor at each stage must be paid for, and adds to the value of the commodity, until the first owner must yield up a hundred

CATCHING WILD HORSES.

living steeds, to pay for a pair of leather leggins made from one hide. The plains upon which the horses roam present still stranger features. Formerly, when the owner sold his horses, the land went with them as a matter of course; and even now, though he only disposes of the right to catch and slay, and retains his land, he looks upon it as unimportant property.

The half-tame, half-wild animals, as their day of doom draws nigh, are got together in a corral, or round enclosure, near the dwelling of their master. Up to their knees in mud, and with nothing to eat, they employ their time in lowing or roaring, or neighing at each other. Upon the posts of the corral perch a grave company of idle hawks and ill-looking vultures. Large white gulls on the ground, peck at the slops of thick blood, whilst others, on tip-toe, are clapping their wings, which is their manner of yawning after dinner. A goodly banquet do these birds of omen make. Each drop of blood marks where an ox or a horse has died. It is all he has left of his history, and pigs, guils and hawks quickly consume it. Horns and bones bestrew the ground, but are of little worth, till shipped to the comb-makers and bone-workers. The beef and the tallow are often wasted.

The word *hides* is applied by dealers in leather to the skins of the larger animals as the ox or horse, and is distinguished from *skins*, which are those of the smaller animals, as calves, sheep, goats, seals, etc. The skins of small or yearling cattle are called *kips*.

Then we have *flint-hides*, *i. e.*, hides dried in the sun; *green* or *raw hides*, raw, untanned hides with the hair still on; and *wild hides*, hides from wild cattle; all of which designations are necessary in the manufacture of leather.

CORN, WHEAT AND MEADOW GRASS.

NOW that we have seen how many things in nature contribute to our needs, and have gone through the different stages of manufacture to find out how our clothing is made, let us inquire where the food we eat comes from, and how some of the many things we enjoy are made and improved by the industry of those who labor for the world's good.

It is said that the *farmer* is the most important man in the world, because the chief necessaries of life are

grown and thrive under his care, and without his superior knowledge and activity a great many useful and appetizing things might be lost to us.

Grass we might consider as being the staple of food, for it is from this class that we get wheat, corn, rye, oats, barley, etc., and consequently it is the most important of all vegetable products. People have always used the seeds of these plants for food. They grow in all countries where man lives. The seeds of all these grasses are properly corns, and because from the flour formed from them various kinds of bread are made, they are called bread corns; a grass which produces bread corn is a cereal. Barley is the hardiest of all the grasses, and will thrive anywhere, even in the frigid zones. The ancient Egyptians believed it to be the first of the grasses used for food, and only two centuries ago it was the common food grain of England. It is prepared for table by *pearling* the grains, that is, peeling off the outer layer.

Rice requires a hot climate; it is very largely used, and forms the principal part of the food of one-third of the human race. Rice is mostly starch, and contains but little nourishment for the brain or muscles, consequently the nations living on this cereal are behind Americans and Europeans in almost everything useful.

Wheat ranks next to rice in importance, but in our

country the most valuable cereal is Indian corn, or maize, as it is more properly called. It is a native of

CORN.

the New World, and was cultivated by the Indians long before the white man set foot upon this continent. It is the largest and handsomest of the grasses, and

considerable heat is necessary for its growth, as is shown by the great height of the Southern varieties.

The color of the kernels ranges from white, through yellow, to dark red and even purple; the shape, from the tiny rice grains of the pop-corn, to the long, sharp kinds of the South and West, and the wrinkled sweet kernels. One Rocky Mountain variety has a husk over each separate kernel.

The kinds most valued are the staple, the Indian-corn, the sweet, and last, but not least, I am sure, in your estimation, the pop-corn. It contains all the qualities needed to sustain life, in one of the cheapest forms, but is mostly adapted for people of active habits of life.

All dishes in which corn is the principal ingredient require long, steady cooking, and perhaps it is for this reason many of the old-time dainties have fallen out of use, the Americans being in too great a hurry nowadays to stop to prepare them. The botanical name of corn is *Zea Mays*. Columbus is said to have brought it to Spain about the year 1520. The early settlers of America found maize growing in all parts of the country.

For the past eighty years our corn crop has been constantly increasing, till now corn is the most important grain-product of the United States. The commercial value is perhaps best indicated by statistics.

The reports of the United States Department of Agriculture for 1884, gave the total yield as over 1,795,000,000, bushels, produced by about 70,000,000 acres of land.

This crop was valued at $640,000,000. The principal corn-growing region of the United States comprises Iowa, Illinois, Missouri, Kansas, Nebraska, Indiana, Ohio, Kentucky, Texas and Tennessee.

The canning of sweet corn, and the use of pop-corn by confectioners are also sources of considerable revenue to the farmers.

Besides being used as our food, corn is given to animals, and is considered the best food for those whose flesh we eat.

The husks, dried, are used for mats, and for filling beds and cushions. The stalks may furnish fuel, thatch for roofs, or may be made into baskets. Paper has been manufactured from some portions. The cobs alone, or soaked in oil, are useful for kindling.

Besides these grasses from which bread is made, there are also some kinds called meadow grasses, which when dried are called hay, and are fed to horses and cows. Fig. 1 shows us one of our most cultivated varieties, called *timothy*, or *herd's grass*, from the name of the man who first brought it from Europe many years ago, Timothy Herd.

Then, there is the *red-top*, (Fig. 2), so called

because of its dark red, or purplish color; and the sweet-scented *vernal* (Fig. 3), which blossoms very early, and has a delightfully sweet odor. The baskets made by the Indian women often have the same

Fig. 1.

Fig. 2.

Fig. 3.

fragrance. These meadow grasses are invaluable to man as food for his domestic animals. They are almost as valuable as the cereals upon which man so largely lives.

Grasses are also useful in making our homes beauti-

ful. The poorest, plainest house becomes pleasing to the eye, if surrounded by a well-kept grass-plot.

SUGAR CANE.

You will, perhaps, be surprised to learn that the sugar-cane, which has been cultivated for ages as the

principal source of sugar, belongs to the family of grasses, as does also the bamboo, so extensively useful in the making of chairs, easels, walking-sticks, flutes and other articles.

Wheat grows in all countries, where the climate is temperate, and the soil rich. The use of wheat has been steadily increasing since the discovery of America, from the fact that the bread made from it is more digestible than that made from any other grain.

Wheat has a large share of an elastic, tough substance called *gluten*, which is not found in any of the other grasses, and it is this gluten, combined with heat, and the addition of yeast, that enables a lump of dough to expand to a loaf of bread three times as large.

There are two kinds of wheat, the hard wheat and the soft, but each kind has several grades.

The quality of flour depends on the kind of wheat, and the mode of curing and grinding.

American wheat is mostly soft, and the climate of the United States, south and west of New England, is especially adapted to the cultivation on account of our sunny skies.

The richest fields are in the valley of the Red River of the North, and on the Pacific coast from Pugets' Sound to Southern California. In both these regions the soil is extremely fertile.

The American wheat is of great commercial value;

about half as much being exported annually as is consumed for food at home. In a single year more than five hundred million bushels of wheat have been raised in our country.

What a beautiful sight it must be on one of the

large Bonanza wheat farms of the Red River, to see those great fields of golden yellow grain stretching away out over the unbroken, level country as far as the eye can reach. To see the hundreds of harvesters in the busy harvest time; the great harvesting

machines drawn by horses, moving across the country like a great army. Forward they move, the mowers laying flat the long lines of wheat, and then binding them in a twinkling into great bundles, ready for transporting to the store houses.

Truly not much like the old-fashioned farming, where one man used to go out with his scythe, his pitch-fork and his rake, and do all his reaping and binding alone.

STORY OF TEN LITTLE GRAINS OF WHEAT.

HOW the millions of wheat grains did fly from the hand of the farmer that day in early spring when our ten little heroines fell to the ground!

A rough roller was passed over them, pressing them down into the warm moist earth. A few days of sun and rain, and these little people threw off their husk-like coverings, sent little roots into the ground, and pushed tiny blades which looked like fairies' swords up into the light. Countless struggles had the farmer with weeds, which threatened to choke them; with slugs, worms, and crows which longed to devour them. But the blades grew tall and strong. What fun it was to wave in the breeze, and to carry nourishment up through their long stems to fill out and ripen the fine ears of wheat forming at their tops! At last, when the whole field was so golden with the ripened grain, that it seemed as though the sun was shining there, even in rainy weather, the farmer came to reap. Some farmers use machine reapers, but these ten sisters and their countless cousins were cut with a sickle, and bound into great golden bunches or sheaves. They soon found themselves spread out upon a wide, clean

threshing-floor when the farmer and his men beat them with flails; — long-jointed sticks with hinges of leather. Thud! thud! went the flails till the kernels were all beaten out of the sheaths.

MACHINE REAPER AND BINDER.

Then the sisters saw their stems or straws carried away to the straw-workers and paper-makers, or sold for bedding for the cattle. But their kernels were put into a great machine, with a revolving fan, to be winnowed or blown clear of husks. Now some of these sisters had grown too near together to be able

to make their kernels plump, and some had been nibbled by insects, which of course made them lighter in weight than the healthier and more fortunate of their family. When the fan began to blow a strong current of air upon them, the chaff flew away to the far end of the machine and settled down together. The kernels, which had not grown stout and heavy, flew away by themselves also, though not so far as the chaff; while the strong, perfect kernels, or grains, lay in a heap nearer than either to the fan. The "firsts" or best grains, and the "seconds" or poorer grains, were put into separate sacks and sent away to the mill. Some flour mills move by wind, some by water, but it was a great steam-mill to which these grains were sent. Here, to the relief of these dainty maidens, the sand and seed of weeds which had crept in among them were removed by machinery. Then they were lifted from one floor to another in small boxes which were mounted upon endless bands, and tumbled all together into a great bin.

Then came a journey all in the dark through the spout of the bin to the hopper, and another short trip from the hopper to the opening which let them slip in between two round, rough and monstrous stones. How the stones did seize them, and crush and grind them between the jagged edges of their grooves, as if they themselves were actually hungry for bread!

Nor did they yield them up until they were ground into flour so fine you could not tell one sister from another.

Next they were put through sieves turned by machinery, and sifted and sifted until every bit of bran — bits of the outside skin of the kernels — was taken out.

"Where shall we go next?" thought these little people as, white and soft as snow, they were put into barrels and bags again.

"We should not have been put through all this," said one, "unless we were to be of some use in the world. All this ploughing and harrowing, reaping, threshing, winnowing and grinding means something."

Had you noticed these grains as they were being ground, you would have seen a fine white powder; this was starch. If you wash a piece of dough with water, on a piece of muslin tied over the top of a tumbler — the water in the tumbler looks like milk and, in a short time, a white powder settles: this is the starch; but what is left of the dough is a tough, sticky substance called gluten. If we can force gas into these tiny globules of gluten, each one of them will swell up, as will soap-bubbles when you blow air into them, and make a sort of solid froth. This is what we mean by "making the bread rise," and why we put in yeast.

When these globules are well puffed up by the yeast, the loaf, when you cut it, is full of little holes, will easily soak up the sweet milk in your bowls and you say it is light or spongy. When the globules are not well swollen, you do not see these pores and say the bread is "heavy as lead." The brown crust on the top of the loaf is the starchy part of the flour colored by the heat. But this wheat, whose story we are telling, was taken to a biscuit or "cracker" factory; stored in the upper room, it was let down through a shute to the next or flour-room, where it was sifted free of lumps. Water was added, and the whole put into a great cylinder whose revolving knives slashed savagely about to mix the dough. In a great lump this dough went to the rolling-machine, which pressed it out to an even thickness between heavy iron rollers. This sheet was carried forward to a machine which really seemed to know what it was doing as it rolled, cut out the round bits of dough, punched the holes in them, shoved them into the great tins and sent them spinning away to the great ovens. How do you know, but what that very "cracker" you were munching last "recess" was made from some of these ten little sisters?

BREAD-MAKING.

BREAD-MAKING.

IN this age of machinery it is very likely that machine-made bread will soon supersede the bread made by hand. We are all familiar with the way bread is made at home, by the simple process of mixing flour, water and salt and adding yeast to make it "rise."

In olden times yeast was unknown. Our great-grandmothers used "leaven," which usually required about two weeks to prepare, by mixing flour and

water together and keeping till they "fermented," or until the dough became spongy, with little bubbles rising through it. These bubbles were full of gas,—what is called carbonic acid gas—and a small lump of this leaven would make other dough rise in a few hours.

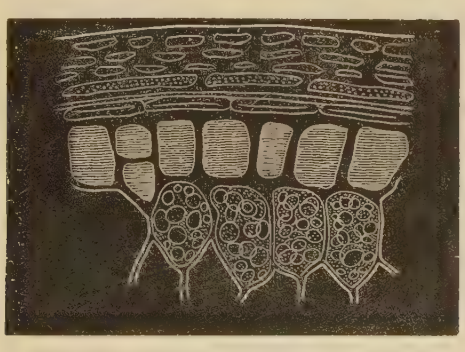
Yeast is the froth that rises to the top of malt liquor. It is thick, like cream, and after being taken off, is partly dried, pressed, washed and then cut into little blocks. Then it is called *compressed yeast*, and you have seen how it comes to us in those little blocks, rolled up in tin-foil.

This yeast, when put into flour, changes the starch into a kind of sugar, called glucose; the sugar again dissolves into carbonic acid gas, and the gas swells the dough, or as we say, "makes it rise." The gas escapes during the baking of the loaves, leaving holes, which makes the bread light and digestible.

There are other processes of making bread without either leaven or yeast. If we mix saleratus or soda, and a little spirits of salt with the dough, and then put immediately into a hot oven, the heat will make it rise and bake it at the same time.

Another way, introduced by an English physician, is much used in large bakeries where there is a great demand for a quick and wholesome way of making bread.

It is called the aerated process; the carbonic acid gas is prepared beforehand, and forced into water, which is used for mixing the dough. In the preparation the dough, or sponge, is allowed to distend gradually, and all the work involved being done by



SEGMENT OF WHEAT KERNEL, MAGNIFIED.

machinery, flour can be changed into bread in the short time of an hour and a half.

The importance of machinery in bread-making is as great as the use of machinery on the farm.

More and better loaves are made, and the bread is more wholesome. It gives employment to numbers of people, and is an immense saving of time.

A DAIRY FARM.

MILK, BUTTER AND CHEESE.

THE best of the food which dear old White-face and Brindle, the cows, are munching so contentedly will, when digested, be taken into their blood. Milk is a white fluid which separates from the blood and collects in certain glands called milk-glands. This is the reason why the milk often tastes of turnips in the winter, and why, in June, it seems to be flavored with the sweet clover blooms.

Cows are milked two or three times daily; in the morning and evening, or morning, noon, and night. They must be kept very clean and always be milked quite dry. The last milk is supposed to be much the best. If the cows are left too long without milking,

MILKING TIME.

they suffer pain, and if they are not well drained every time, they soon begin to give less, until, at last, no more milk will come.

During the process of milking the cows, small particles of hair, wood, and other matters, are apt to get into the milk-pail. The milk has therefore to be

strained through sieves into the milk-pan, set away for the cream to rise, or poured into tall tin cans for the milkman.

It is carried to the dairy in shining pails, kept clean and sweet by scalding and scrubbing after every time of using. The dairy is fitted with shelves, on which stand wide shallow dishes, to hold the milk while the cream rises. The windows are of wire gauze to let in the air and keep out the dust.

The matter which constitute milk are — 1. The aroma, or that part of the milk which gives the odor or smell. 2. Water, of which the greatest part of the milk consists. 3. Bland oil, from which the cream is formed. 4. Curd, or clot, which is the same as the gluten in flour, and is the part from which we make cheese. 5. Sugar. 6. Various salts dissolved in the fluid.

In the course of a day, or a day and a half, the cream, or oily part of the milk, has risen to the top, and is skimmed off with a skimmer. The rising of the cream is due to the fact, that it never was dissolved in the milk, as sugar dissolves in tea, or salt in water, but floated about as tiny globules in the liquid, too small to be seen; and when the milk was spread out in the pans and kept perfectly still these globules took advantage of the chance to push themselves up to the surface. You know that milk can be kept

only for a day or two before it "sours." This is because an acid is formed by fermenting and some of the "milk-sugar" has disappeared. Because of this unpleasant habit which milk has of growing sour, a gentleman of New York studied until he found a way to prepare milk so that it might be kept for a long time. This plan was to remove a greater part of the water contained in the milk and to add sugar. This is done in factories where the new milk is strained, heated by being set in cans into hot water, sweetened with the best sugar, subjected to steam, set into cold water and finally poured into large drawing cans with faucets. These faucets make very easy the work of filling the small tin cans which hold about one pound each, and which were immediately sealed with solder to keep out the air.

BUTTER.

When all the cream has been skimmed off, and enough of it taken for breakfast and tea, and home use, the rest is put aside until "churning day." The cream is generally stored in jars away from the milk-room, lest, when it begins to grow acid, it should sour the new milk. It must be stirred a number of times a day or turned from one vessel to another, else a thick tough scum rises to the top and

grows bitter. Three days is as long as the cream is kept for the best butter. The milk of some cows is very much richer than that of others in oil or butter; if the cows are hurried home from the pasture their milk becomes poor, with but little butter in it.

DAIRY.

Churning requires much skill and patience. Cool temperature of both the cream and the air in the dairy is best for churning; so the early morning is the best time for it.

In old times it took three or four hours for the but-

ter to come and the labor was very hard. But the tall, upright churn, looking something like a firkin with a "dasher" in the middle, has gone out of fashion.

The barrel-churn came next and was a great improvement upon the upright churns; yet it, in turn, has grown old-fashioned. The barrel-churn was made with beaters inside which flew round and round as the handle outside was turned. As the beaters struck at the cream the oily atoms united into lumps. The butter was "coming." Sometimes, let the dairy-maid do what she will, the butter will not "come," or comes at last in tiny grains that will not cling together, and can only be strained away from the watery part of the milk which is left and which is called butter-milk.

But inventions and improvements have been made, until, now, the churning can be done in a few minutes.

When the butter is taken out of the churn before it can be salted, it must be kneaded and "patted" till any butter-milk which may have been left is taken out. If any of the butter-milk—which you can often see in clear drops which look like water upon a cut surface of butter — is left, the butter grows "strong" or "rancid" in a short time.

Much of the butter-making is now done in factories or "creameries," and the farmers have deep tin

cans immersed in ice-cold water for separating the cream from the milk. In this way the milk is kept so cold as to be quite sweet when the cream is drawn off.

CHEESE-MAKING.

CHEESE.

Cheese-making is the most difficult part of dairy work. Certain substances, if put into new milk, will make it coagulate or "curdle" in a short time. *Rennet*, a part of the calves' stomach, will curdle the milk.

The white, thicker part of the soured milk is the *curd;* the clear, watery part the *whey*. The whey is drawn off and worked out until the curd is left dry and crumbling. The curd is salted and put into the lever press on the same day in which it is made. Next

CHEESE MARKET.

morning it is turned over and a coarse cloth put upon it to give it a smooth surface. On the next morning a fine cloth is spread over it. After another day in the press it is taken out and laid upon the shelf to dry or "ripen," as dairy men say.

MEATS.

BEEF stands at the head of all flesh foods in its power to sustain life. Oxen are the lords among food animals. Every part of the huge bulk of the ox has its admired quality, not approached by other meats.

To look an ox in the face, one might well wonder when the thought first came into a man's mind to eat him. We can almost believe the fable of the fierce creature addressing a fair and beautiful young lady, and asking, "Who could it think of us that you, with your sweet and innocent face, are going to eat me, and that I, with my terrible head and horns, am not going to eat you?"

Some devices to preserve dead meat have been practised in every age and country. All animal and vegetable tissues contain oxygen which causes them

to decay. Smoking and drying meats send the water off in vapor. Pickling, sugaring, salting or corning absorb the water. Freezing reduces the juices to a solid state. In these ways the oxygen is either got rid of or kept from acting upon the tissues.

Salt is applied either dry or as a brine, when the meat is said to be "cured" or "corned."

Dry salt is used to change pork into hams and bacon. When slightly salted, hams are called green hams. Much bacon is "sugar-cured."

Salt beef and salt pork were, at one time, nearly the sole flesh food of sailors, and were a cause of the scurvy which then made fearful ravages in many a brave crew. Salt beef, when varied with fresh meat, is both wholesome and savory.

In smoking animal food the fuel used gives off an acid, call wood vinegar, and a substance of the nature of tar, called creosote, both of which possess a powerful property in preventing decay. Creosote clots or coagulates the albumen of meat, just as heat coagulates the glare or white of an egg.

As the smoke slowly penetrates the meat, it effects these changes, while it dries the tissues and imparts a fragrance to the food, in character with the fuel.

Jerked beef is prepared in South America and the West Indies, by cutting the meat into strips, soaking them in brine, and then drying them in the sun.

The Indians cut the flesh of the deer and other animals into slices, remove the fat and then dry it in the sun. This, when pounded with the fat and potted, is the food of the fur hunters in the North.

The great problem has ever been to preserve animal food in a fresh state. Human genius has in a measure solved even this difficulty. In countries where the climate is extreme and the winters lengthen out, the intense cold converts birds, beasts, and fishes, as soon as the life-blood ceases to flow, into frozen masses like stone, which are collected, packed, and sent to market. In many places the meat is placed, as soon as killed, in ice-houses, and cooled down to freezing point.

Canned meats have, of late years, been largely used in place of so much salted and dried meats; while prepared extracts of beef are of inestimable value to invalids and for making gravies and stock for soups. These preparations are all of great importance, but science has not yet made them to excel, or even equal, the fresh food from which they are procured.

TRANSPORTING AND CANNING MEATS.

In Chicago is an establishment where 200,000 head of cattle are slaughtered every year and "canning" is carried on to a great extent.

In through the gates troop the unsuspecting cattle: choice "corn-fed" animals from the West and "grass-fed" Texas cattle from their summer rambles.

The part of the yard which they enter is boarded at the sides with plank seven or eight feet high, but is open at the top. As an animal is wanted he passes into the pen nearest him. A few seconds later and he is killed, falling dead without a groan or struggle.

The door at the other end of the pen is raised, a hooking chain passed round his neck, and the dead animal is drawn out upon a broad platform. The head is taken off, and four men strip down the hide, while two others take off the feet.

Sawing the breast and haunch-bones come next, and then the carcass is hoisted and men fall to work trimming and cleaning it. Nothing is wasted, not even the horns and hoofs.

All the while these operations have been going on, the carcass has been moving along a distance of two hundred feet, being fastened to a track over-head. The men stand still in their several places, and, as the body is moved along to them, each one performs his part of the work.

In about fifteen minutes from the time of his death the animal who passed through all this, has been cut into "hind" and "fore" quarters and carried into a room to cool.

When the meat is thoroughly cold the cars are run up near the cooling-room, and the great quarters of beef are hung from the hooks at the top of the inside

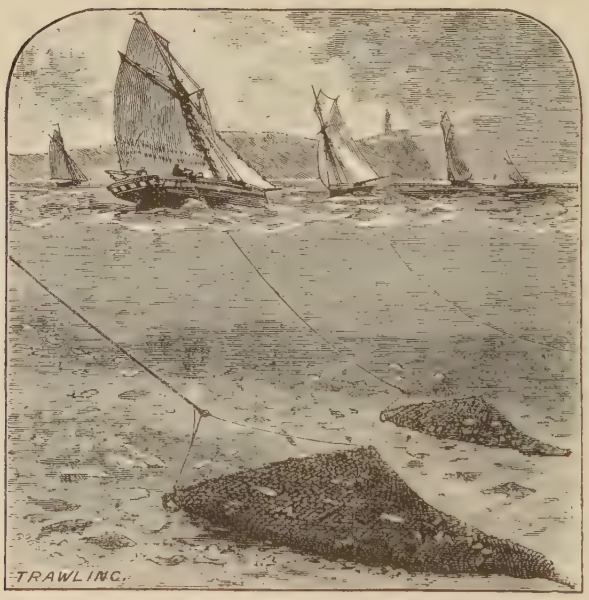
of these cars. The floor is left for the sausage meat. The car has its side-walls double, and a current of cold air is forced between them from the refrigerator in the front of the car. When the car is closed it is air-tight and the meat can be carried a long distance and be kept fresh.

A great deal of it is carried to the ships to be taken away to foreign lands. Each quarter, after cooling, is sewed up in coarse sacks and taken to a room on shipboard especially prepared to receive it.

This room is lined, floor, walls, and ceiling, with oil-cloth and has a refrigerator underneath, from which cold air is continually fanned upon the meat.

In another department canning is going on. Here is one man who does nothing but separate joints, with a skillful twist of his knife, all day long. A hundred others are on the same floor with him each performing his separate and only duty. When the carcass has passed through all these hands it will be entirely free from bones and will be wheeled away to be canned.

The meat is first cooked, then put into the cans and the cans closed and placed in a retort. Steam pipes heat these very hot Next, the cans have holes made in the tops to let any air that may be left, come out. Then they are sealed and heated again. Then the labels are put on, and the cans are packed for market.



FISH.

THERE is one harvest which rewards labor all the year round, without ploughing, or sowing. Our fisheries are a rich source of wholesome and varied food. The seas that wash our shores and the rivers that water the land teem with fish. Fresh-water fish, however, except salmon, which is both a fresh and salt-water fish, and the choicest of all kinds, are more

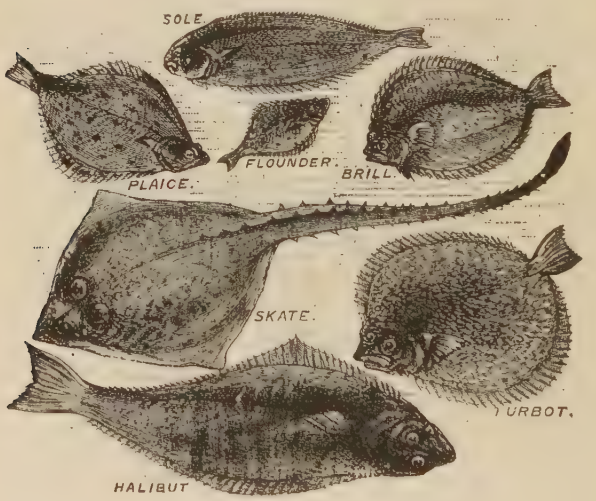
often valued for the sport they provide for anglers than for the market. Sea fish, on the contrary, are of the highest value, both on account of their immense numbers and variety, and for their excellent qualities as food.

DRAWING IN A NET.

There are home fisheries and distant fisheries; fishing-grounds that are netted all through the year, and others only at certain seasons. An important fishery is that of Newfoundland, off which island the "banks" abound with wide-mouthed cod.

The sea is the scene of never-ending warfare.

Fishes of every size prey upon others which are smaller. Large fish have been caught, inside of which have been other fish, and others again inside these last. As they were fresh and whole, they must have all been swallowed within an hour.



GROUP OF FLAT FISH.

The so-called flat fish, turbot, brill, plaice, soles, flounders and halibut are generally found near sand banks. They are not true flat fish, but the two sides are pressed together. If you notice the back-bone when you have one of these flat fishes on the dinner-table, you will see that they really swim and rest on their sides.

The fish on the sand-banks keep to the bottom of the water, where their food prevails; hence they are called ground-fish. They are caught in a trawl net by the fishermen. The trawl drags or "trails" along the ground as the vessels sails along, while a

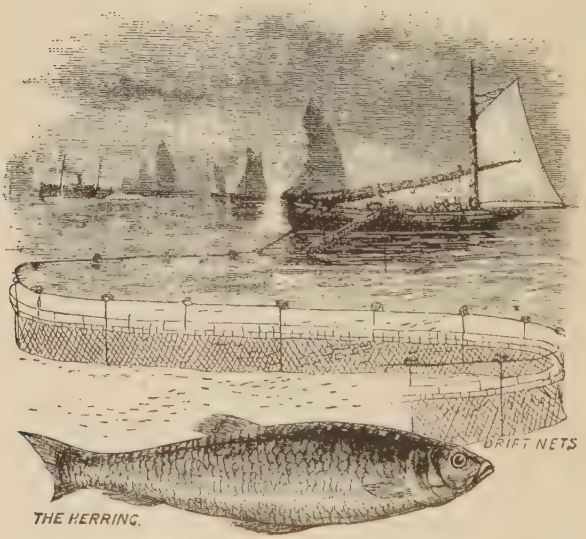
OYSTER DREDGING.

long heavy beam and ground-rope rouse the sleepy fish from their dreams, and sweep the victims into a wide-mouthed bag.

The net is hauled up on deck by half a dozen stalwart men, with a measured song or chant of "Heave her, now, now; heave her, heave her."

As the great bag is pulled in, mesh by mesh, the fish

flounder and wriggle down into the pointed end of the net, which is then lashed or tied and soon shows the amount of the "take." Then the huge purseful of fish is hoisted on to the deck, the end is untied, and out



the captives roll, flap, and struggle in one heap: the writhing, quivering creatures, with the crabs running about, making a lively scene. Each "hand" pulls out his knife and sets to work. The fish are killed, the inwards removed and thrown overboard. The fish are then washed in buckets of sea water and sorted in boxes.

Among the most important are the herring fisheries. Herrings are caught in drift nets which hang down in the water like a screen. The line of net at the bottom, sinks with plummets of lead, and the line at the top floats with inflated bladders or corks.

The herrings drive on the net and entangle their gills in the meshes, made large enough to admit their heads, which they cannot draw back if they tried, because the lids of their gills at once open. They have not even the sense to try, but drive forward, and fix themselves the more firmly in their trap the more they are obstructed.

The salmon leaves the sea at certain seasons, to spawn or lay its eggs in the rivers, and is then in its finest state. After the salmon has deposited its eggs, and returned to the sea, it is poor and thin, and not fit for food. While going up a river it lets nothing stop its passage, but will leap over rocks, or anything in its way, to get to the higher waters.

Salmon fishers, knowing the habits of their prey, fix weirs or sluices across the rivers, leaving just a narrow pass, and place baskets, traps, or stake-nets for the fish to fall into. Salmon-spearing is a night sport and done by torchlight. The salmon, drawn to the glare like moths to a candle, are thrust through with the spearman's lance. Salmon are also often caught with rod and hook.

Mackerel die quickly out of water because of the wide spreading of their gills. They are caught in drift-nets like herring.

The cod, ling, and haddock all belong to one family, their big, wide-open mouths showing how greedy they

SALMON FISHERIES.

are for food. They swim near the sea-bed and swallow small fish at a gulp.

Vessels engaged in codding take eight or ten men on board. For the long-line fishing, the work of laying the lines is done early in the morning. A lantern on a "captain buoy" is anchored at the starting-point, or a boat manned by four or five hands is left there,

while the vessel sails away, laying her lines as she goes, now and then attaching a small anchor to keep them steady. As a rule, six or seven miles of lines are laid at a time, a buoy marking every mile. At intervals of eight or ten feet smaller lines about a yard long, called snoods, are hooked and baited.

ROD-FISHING FOR SALMON.

After all the lines are laid the craft is put about, and, having regained the captain's buoy, they lower a boat for the purpose of hauling in the lines. The boat, like the vessel, has a well, into which the fish are tumbled as fast as they come to hand. Now and then a cod, from being badly hooked, breaks away.

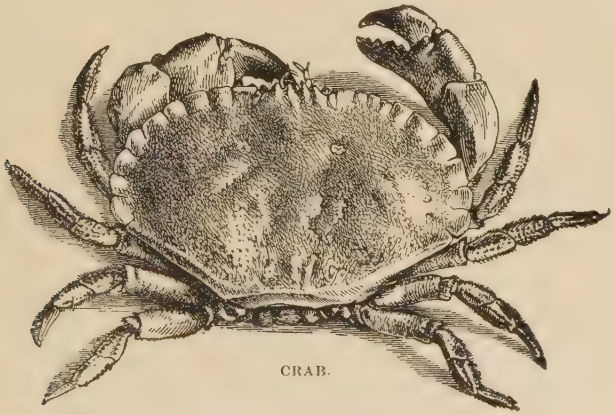
When a boat has taken in as many cod as the well will hold, she signals, and the vessel sails down and relieves her of cargo and lines. In the boat, while the lines are hauled, a man keeps bailing out water from the well, while fresh water streams in; otherwise many of the fish would die before they reached the larger vessel, or fishing smack.

CATCHING A LARGE FISH.

The grandest codding station in the world is Newfoundland. There are also important cod-fisheries on the coasts of New England, and very valuable ones exist on the shores of Norway.

Lobsters and crabs, some of very large size, choose the dark and rocky recesses of the coast, where, like their first cousins, the spiders, on land, they lie in wait to pounce upon unwary intruders. They are

tempted out of their lair by baits, such as bits of fish, placed in wicker pots of the shape of a hencoop, but which, like rat-traps, are easier to get into than out of. The opening is at one side, where the willows turn inwards and downwards, tapering like a funnel, and yielding an entrance to the biggest crab, but fortified against any exit by a close circuit of spikes.



CRAB.

The fishermen sink their pots over night by means of weights, and mark the spot with a buoy. They raise the pots in the morning, haul them to shore, and collect the booty.

Curing fish is done in two ways. One called pickling consists in packing the fish, with layers of salt in barrels, after they have been split open, gutted, and part of the backbone and the head removed. When

they are to be cured dry, they are unpacked and spread out in the sun. When thoroughly cured they are kept cool and dry till they are shipped.

THE FISHERMEN.

HURRAH! the seaward breezes
Sweep down the bay amain;
Heave up, my lads, the anchor!
Run up the sail again!
Leave to the lubber landsmen
The rail-car and the steed;
The stars of heaven shall guide us,
The breath of heaven shall speed.

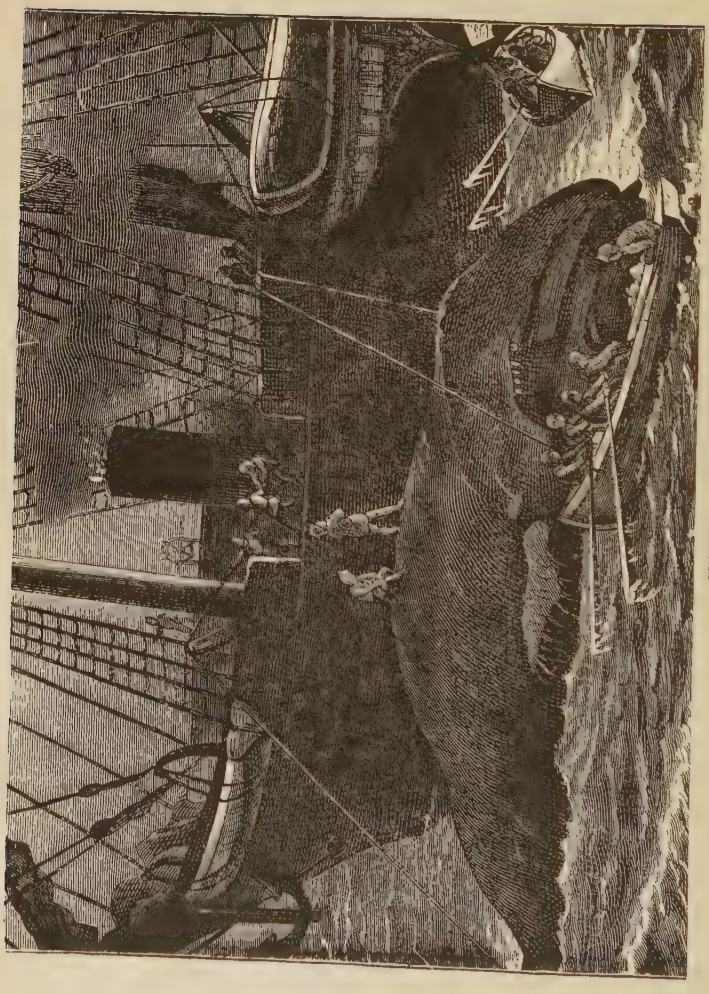
* * * * *

There we'll drop our lines, and gather
Old Ocean's treasures in,
Where'er the mottled mackerel
Turns up a steel-dark fin,
The sea's our field of harvest,
Its scaly tribes our grain;
We'll reap the teeming waters
As at home they reap the plain!

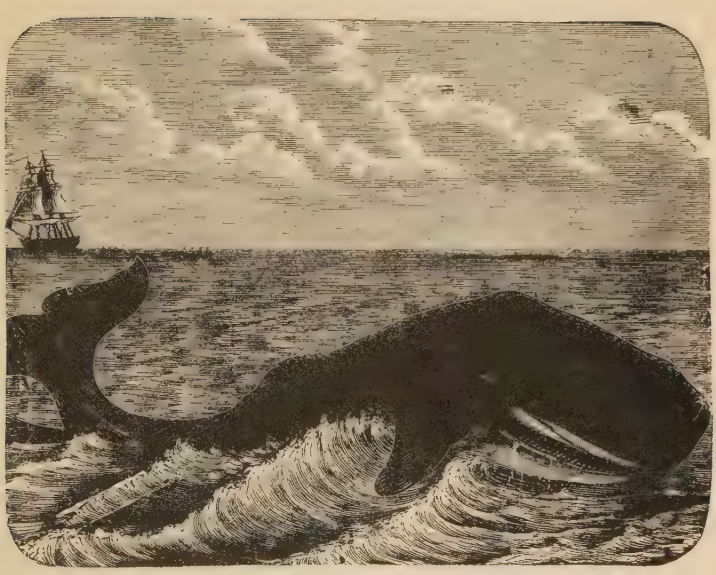
* * * * *

Hurrah! hurrah! the west wind
Comes freshening down the bay,
The rising sails are filling,—
Give way, my lads, give way!
Leave the coward landsman clinging
To the dull earth, like a weed,—
The stars of heaven shall guide us,
The breath of heaven shall speed!

—WHITTIER



CUTTING UP A WHALE.



THE GREENLAND WHALE.

WHALE FISHERIES.

GREAT numbers of men are employed in the dangerous business of catching whales — the monsters of the sea.

The American whale fisheries are the Arctic and Bering Strait fisheries of the North, and the sperm whale fisheries of the South.

The kind of whales most useful are Greenland and sperm whale. The Greenland whale is most valuable for its whalebone ; the sperm for its oil and spermaceti.

The sailors have a share in the profits of the trips,

so, as the whaling-ground is neared, each one keeps a sharp look out for signs of prey. When the whale comes up to the surface to breathe, if in cool latitudes, his breath can be seen, just as yours can when you are out of doors on a cold day. This breathing or "spouting" as the sailors call it, can not only be seen but heard for several miles.

As soon as a whale is seen there is a great cry of "There she blows!" and a hurrying about lowering and manning the boats. Each boat tries to reach the poor animal first. As soon as a boat is near enough, the harpooner throws, with all his force, a harpoon into the creature's body. And now the poor whale dives into the water, unwinding the rope to which the harpoon is attached so swiftly that water must be poured over it to keep it from taking fire. The whalers can tell by the direction of the rope in the water where the whale is likely to come up again to breathe, and boats are stationed near that place with men ready to strike him with another harpoon.

Now and then a whale drags men and boat along with him for hours. When the whale is dead, it is towed to the ship and its head is cut off. If it is a whalebone whale, some of the men take out the plates of tough bone and stow them away.

If it is a sperm, a large hole is cut in its head; some of the men dip out the oil in buckets-full. As

this oil cools a part of it separates itself from the oil proper and looks like partly melted lard. This is spermaceti. It is soon firm enough to be taken out of the fluid fat and put into separate barrels. At first considerable oil is mixed with it making it look greasy and yellow but after being purified it becomes hard and white like that we buy.

Twenty-four barrels of spermaceti have been taken from one whale. The jaw-bones being full of oil are hung up so as to allow the fat to drain out. The tongue is very fat and furnishes five or six barrels of oil. But these men on board are not the only workers. While the body of the whale floats alongside the ship, men pass long ropes around the carcass. These ropes run upon pulleys and great hooks are attached to them. Loosening a piece of "blubber" or fat near the neck, the men begin to tear or unwind it in a long spiral strip from the neck to the tail. The body rolls over with great splashings, and, when finally stripped, sinks quickly into deep waters, as it is no longer made light by its envelope of fat.

Now the men cut up the blubber and put it into great caldrons to boil. After it has been boiled some time, the scraps are used to keep the fires burning, so the whalers do not have to carry coal for this purpose. Spermaceti is used in making candles; sperm-oil is used for burning and for machinery.

GROUP OF FRUITS.

FRUIT.

NOW, let us look at something which Nature made all in her own wonderful, silent laboratory. How quietly she went about it, neither fretting nor disturbing any one, not even the bees which crowded around the blossoms, nor the birds when they snatched a few of those delicious cherries. She fashioned them all at the same time, too; yet all of them are perfect.

No wonder that the works of such a master,

wrought out in the sunshine and sweet air, are so wholesome and delicious.

Every one has a story of its own, from the great pineapple which gathered up its delight for you beneath southern suns, to those yellow Bartletts which grew by your own door. You know, of course, that

COCOANUT TREE.

these delicious bits are only the ripened seed-vessels of different plants.

Those cherries, plums and delicate peaches and grapes have hidden their seeds away inside the pulp. The melon there has its seeds scattered through the inside like plums in cake; but the raspberries and strawberries and the pineapple have kept theirs on

the outside. Peas and beans are fruits, though not as beautiful, that have hidden themselves away in pods.

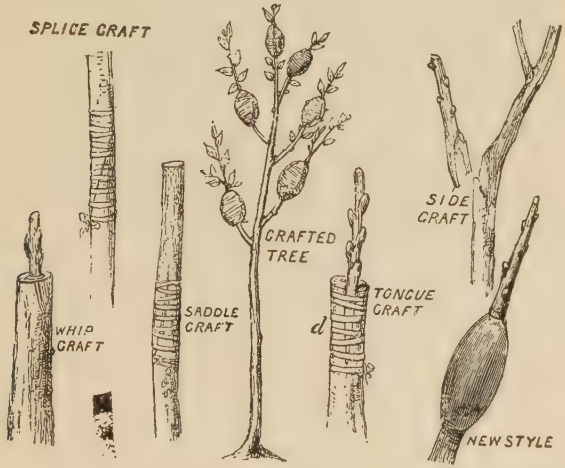
The dusky people of the Torrid Zones depend almost wholly upon their fruits for food. Cocoa-nuts, bananas, which are fruits of the palm trees, are the mainstay of the Indies, as bread-fruit is of the Pacific islands. Dates are the chief source of wealth in Arabia, where they are as necessary as spring water.

Figs grow upon bushes or small trees with broad, rough leaves, and form the chief food of the natives of Western Asia and Southern Europe. But who knows more of the uses and virtues of fruits than do you healthy and happy boys and girls?

To grow fruit from the seed produces spurts or new varieties. The usual course followed is by layers, cuttings, buddings, suckers, and grafting. The common gooseberry and currant form natural layers, when, bending over with the weight of fruit, their twigs strike fresh root, and by cutting them asunder grow into separate plants.

Cuttings also, from any part of the bush, may easily be made to strike root. A sucker is an underground shoot, which rises at a distance from the parent stem. But the larger fruit-trees are grafted. Grafting is the union of two plants in a growing state, through the medium of the sap, just as when our flesh is gashed open from any cause, the two sur-

faces unite again under proper bandages. Trees often graft upon each other. If two branches by their nearness, rub together till wounds are made by the friction, and they bleed, the sap from the two mingles, while wood is formed, and the two branches are welded in one. Quickset hedges, by such means, thicken into a strong network of defence.



MODES OF GRAFTING.

A grafted tree consists of a stock or stem, and scions or slips inserted into the stock. An opening or cleft in the stock receives the graft or scion, which is cut to fit so neatly that the two edges of it shall be exactly even, or shall bevel with the stock. A plaster of clay and earth protects the parts until

they unite, and the shoot feeds upon the rising sap. As the changes, which the sap undergoes, take place in the leaves, the grafts, however many, produce their own varieties of fruit.

A HARVEST HOME.

It is not long since we with happy feet
Stood ankle-deep in grasses fresh and green;
While in the apple-blossoms pink and sweet
The singing birds, with flashing wings, were seen.

It is not long ago — not long ago —
Since the glad winds ran through the tasseled corn:
This way and that way, swaying to and fro,
The golden wheat waited the harvest morn.

Now all the silent fields are brown and bare
And all the singing birds are gone away;
But peaceful calm is in the hazy air,
And we, content, can watch the sweet decay.

For so the hay is saved, the corn, the wheat,
The honey from a thousand scented bowers,
While russet apples delicately sweet
Hang where once hung the pink white apple flowers.

CULTURE OF THE SUGAR-CANE.

SUGAR.

BUT here is a tall plant which waves her tuft of pretty blossoms and long slender leaves growing at the top of her stem, as much as to say, "Tell *my* story to the children: I am sure they love me." It is the sugar plant or sugar-cane. Her home is in the Southern States and in the East and West Indies grow many of her sisters.

Did you ever notice the *joints* in the stem or stalk of Indian corn. The sugar-cane is "jointed" in much the same way. The sugar-cane's stem is hard on the outside, but the inside is soft and juicy, not hollow like the stems of grass and barley.

CUTTING DOWN AND BUNDLING SUGAR-CANE.

When the "sweet" maiden was only a slip from the top of an old "cane," and when she first began to grow, she had leaves the whole length of her stem; but as fast as she grew tall and her joints ripened and her

stem grew hard, as if to lock the precious sweet juices safely away, her leaves fell off, one by one, until only a few at the top were left.

When she had grown as much as she could, men came to the fields, cut her and all her neighbors off at the base of their stems, bound them in bundles and piled them into creaking ox-wagons. A jolting slow journey across sunny fields and they found themselves at the sugar-mill.

Here they were "fed" in bundles to a great steam rolling machine, which seized them greedily, pressed them flat as ribbons, and dry of juice. The sweet juices trickled down into a great trough and from the trough, through pipes, to that part of the mill where they were to be purified and changed into sugar-grains.

From being purified the juices passed on to a number of great pans over a fire; here they were "boiled down" and passed from one pan to another until, in the last, they were condensed so much that, when allowed to cool, they would form into tiny granules or crystals. But when they were cooled they were brown looking and there was much molasses with them. Accordingly, a few days later, they were put into hogsheads in the curing-house, and the molasses drained away from the crystals into tanks. But the sugar crystals were still brown, and not dainty and

delicate enough for our tables; so away they had to go to the sugar refiners. Here they were melted, tons of them at a time, in great cast-iron tanks, set in hot water.

Next they were strained through twilled cotton bags with outside casings of hemp. But they still were brown. What could be done to take away their dusky color, and that strong "brown sugar" taste? From the bags the melted sugar had to pass through beds of — now what do you suppose? — *animal charcoal!* Would you believe it? *the liquid sugar which oozed out at the bottom into tanks was clear and colorless!*

From the tanks it went to another great pan to be boiled down again and when, at last, the liquid had cooled there were the tiny granules again, this time as white as snow. When loaf-sugar is made the hot liquid is poured into molds, and the syrup allowed to drain away after the "lump" or loaf of sugar has cooled. The loaves are then placed in a stove for drying.

A great deal of sugar is made from beets. There is a kind of sugar in the European market known as "palm sugar" which comes from the sap of several palms. Another kind of sugar is made from starch.

And who has not read about the maple sugar-making in the more northern of our States? Of how, in early spring, holes are bored in the trunks of the sugar-maple trees near to the ground and

buckets set beneath. Of how the sap, which had started on its way to the twigs and leaf-buds far up above, but which, finding an opening, crept out to delight the children's hearts. Of how it is boiled down in kettles in the forests over roaring log-fires.

But here is a modest little fellow who can make a sugar sweeter and purer than are any of these. No whirling, noisy, dirty machinery for him. No need to purify the clear liquid he stores away. There is

BEE.

no hurry or worry about his work, no ordering about of scores of workmen. He does all his work himself; the gathering up of the sweet juices which the flowers hold out to him; the carrying them from place to place; the building of the clean, air-tight cells and the storing the honey away in them. About it all he goes contented, dressed always in that neat jacket of black and yellow, and humming a low song all day long.

Find us a better workman than he, if you can, or a sweetmeat equal to his delicious honey.

CANDY MAKING.

CANDY.

I SHOULD like to tell you, children, of a visit I made with some friends while passing through the pleasant old town of Peabody, not long ago.

You remember the name, G. W. Peppers, that has smiled down at us so many times from the charmed ends of candy boxes? We visited his establishment. Yes, actually set foot in that realm

of sweetmeats! "*Positively no admittance*," frowned forbiddingly at us from over the office door, but we begged so hard that the mysterious-looking doors swung wide open for us.

We went down some steps and into a long, low room. Here were no fairies moulding delicious bits, but strong men working away with all their might. There was sugar in boxes, in barrels, in tubs on the tables; and sugar boiling over a brick fire-place at one end, the scent of it pervading everything, and making brother Tom feel — so he said — like singing, "Life is so sweet."

We felt like intruders at first, but the men came forward, cordially inviting us to watch the operations and ask any questions.

We went over to the fire-place. Great metal pans filled with sugar, water, and a clear, gummy-looking substance, which they told us was an extract from wheat, were placed in great holes over the fire.

A workman took a long, wooden paddle, and stirred the precious contents of the pans so recklessly we thought he must spill half of them; but no, when he had well mixed the sugar, etc., in the first pan he thrust a second paddle into a second pan and stirred away again.

When the sugar was well melted he placed a thermometer, having a glass which was proof against

boiling water and fixed to a cross-wise bar to hinder its slipping down out of sight into the liquid, in one side of each pan.

It would take some time, they said, for the sugar to boil enough to make candy; so we left it bubbling away at a great rate, and went to watch them work upon some which they had poured out, a few moments before, upon the long marble tables. These tables had a rim around their edges to keep the hot sugar from running off and down upon the floor, and were well buttered with a brush before the liquid sweets were turned down upon them.

The clear-looking mass had spread itself out in a great sheet. The workman seized one corner and folded it over to the middle as if he were making an envelope; then another corner, then another, till he had it in one great bundle in the centre of the table where he slapped it, and punched it, and rolled it about in a very disrespectful manner, we thought.

He made some holes in the lump with his fingers and poured in a greenish liquid, which he said was an extract from limes. He was making lime drops, as we had already begun to suspect.

He left the mass for a time and passed on to a second table and treated its contents in the same way. Then he came back to the first and kneaded the extract of limes into the great bundle till it was a pale, green-

ish color all the way through. Then he seized it, staggered across to another clean-looking table and laid it down in front of a little oil stove fixed upon the table. This, he said, was to keep the candy from becoming too hard while they were at work upon it.

He took a little machine made up of two grooved rollers and screwed it firmly upon the table a short distance from the stove. While he was doing this another workman pulled one end of the lump of candy out to a long and rather narrow strip, and cut off a piece with a pair of great shears that clicked as though they enjoyed the feast. One end of the piece cut off he held up between the rollers, turned a crank and lo! out at the other side came the strip, a strip still, but pressed flat and marked out in little squares.

These marked stripes the other workman seized, and slid along to the further end of the zinc-covered table to cool. Another and another strip was cut off, grooved and pushed along into its place, in the same way, until the table was filled with rows of the little squares, and the mass in front of the stove had disappeared.

When the squares had cooled, the men raised the strips a little, and dashing them down against the table, broke them into square lime drops in a twinkling.

The drops were then mixed with powdered sugar,

put into great boxes and upon a dumb waiter to be carried up stairs and packed.

By this time the sugar we had seen put into the pans was ready to be turned out, like the first, upon the long tables. When this had cooled a little, a part of it was colored red from one of the bottles of imported coloring in the rack overhead. The remainder was carried to some great iron hooks fixed in the wall and *hung up!*

We held our breath, for the workmen turned away a moment and the soft candy began to stretch down toward the floor from either side of the hooks. But the men were back just in time and, seizing the ends, stepped back and pulled with all their strength.

When each workman had pulled his candy out into one long strip with one end looped round the hook, he took a step forward, flung the strip deftly over the hook so that it hung down in a loop like a rope. Keeping his hold upon the end he held, he thrust his other hand into the loop, slapped the contents of both hands together, pulled again, swung it over the hook again and so on. He stopped a moment to pour on the flavoring and fell to work again. Every time he pulled, the candy grew whiter and his face grew rosier with the hard work.

When the candy was white enough, it too, was laid by the stove upon a table and drawn out into thick strips.

Strips of the part which was colored red were laid across this lengthwise to make those pretty stripes. Then the men marked and slashed it with long knives, and, as the pieces came off, we recognized our old friends, peppermint "gibraltars."

We went in where they were making peanut candy, where there were such quantities of the speckled bars that we suddenly lost all appetite for them.

Over a fire-place, molasses, peanuts, butter, and the same clear extract we noticed in the first room, were boiling together. These were turned out upon tables to cool, cut with long knives, rattled into pans and hurried away across the yard, to the packing-room.

Seated at another table a man was taking bits from a white mixture, which he said was uncooked cocoanut and sugar beaten up together. He would make a little dab with his right hand at the mixture, always seizing just enough, toss it into the palm of his left, give it a roll and place in a shallow tin close by so quickly we could hardly tell what he was about.

When he had a whole army of cakes drawn up in lines all over the tins he would spring off his stool, and dart away with them to the ovens in the corner. He threw open the wide oven doors and there were tiers of cocoanut cakes, some baked to a delicate brown, others just turning a little; he took out the browner ones, thrust the new tinfuls in their places, placed the

brown ones upon a shelf near by with thousands of others, skipped back to his stool and fell to rolling more cakes.

Next we went up a stairway to a sliding door, which looked for all the world as though it held some precious secret behind it, into — now, what do you think? the *chocolate-cream rooms*.

A gentleman came forward to greet us whom we thought at first must be very old, but we soon found it was the powdered corn-starch flying about everywhere, and not age which made his hair and beard so white.

On one of the long tables was a snow-white mass, large enough to have filled a bushel basket. This, the white-haired gentleman said, was powdered sugar and water beaten and whipped.

Along one side of the room was a sort of trough which looked exactly like an old-fashioned meal chest, except that it was much longer, filled with corn starch. From this bin shallow wooden troughs were filled evenly full with corn-starch.

The workmen took down, from a peg in the wall, thin pieces of wood about two feet long and eight inches wide. Upon the surface of this were fastened objects which were in the form of chocolate drops, and made of some hardened, whitish substance. These boards, with the objects downward, the men pressed upon the trays of corn starch.

Into the hollows made by these objects in the starch they let the "cream," — the sugar beaten up — run from the bottoms of dishes looking like tin tunnels.

When the "cream" had hardened there it was in the shape of chocolate drops bottom-side upward. Then the trays, corn starch, drops and all, were emptied into large sieves. The starch — if there was any which did not fly in our faces — fell through and left the drops alone in their glory.

We followed trays full of these to the chocolate room. In this room four girls were sitting at a frame placed over an oil stove. In the centre of the frame and over the flame was a pan of melted chocolate. Over this pan at either side were wires stretched across.

One of the girls placed a handful of the white drops from a tray beside her into a ladle, gave them a dip into the warm chocolate, turned them out upon the wires to drain a little, and tossed some more into her ladle almost as fast as we could count. The other girls seized them, placed them in orderly rows on shallow trays lined with brown paper, and bore them away to a great refrigerator. They flung the door wide open and there were ranks and squadrons of our dusky-skinned friends drawn up in tempting array around its four walls.

The white-bearded gentleman came forward again as we were coming out and held out a pad of the "cream" to us for a treat.

I shall never eat a chocolate drop again without thinking how his kind face and cheery smile seemed to light up the dreary place and comfort his companions; for it is a dreary place, and hard work, I can assure you, if it is a candy-making establishment.

Funny, wasn't it? every workman to whom we spoke, said: "No candy for me; not a bit of it."

GINGER PLANT.

SPICES.

SPICES are substances coming from plants which have a rich fragrance and a biting taste. Sometimes spice is the root of the plant, as with ginger — sometimes the bark, as with cinnamon ;—sometimes the flower — cloves ;— sometimes the fruit — pepper ;— sometimes the seed — nutmeg.

They are found in the hottest parts of Asia, Africa and America, and the islands north of Australia.

Ginger is an herb which grows from two to four feet

high in the East and West Indies. The best comes from Jamaica. The roots are usually dug when about a year old, just after the stalks of the plant have withered. To keep them from sprouting they are washed, scalded, and dried in the sun. Sometimes the roots are dug when the stalks are only a foot or two in height.

BRANCH OF CINNAMON TREE.

These young roots are very tender and are made into the delicious sweetmeat which you call preserved ginger. Much of the ginger-root is ground for market.

Cinnamon is the bark of a tree which grows twenty or thirty feet high and is a foot or more in thickness. Some of these trees are centuries old and still yielding cinnamon. The finest spice is obtained from young

branches, or from shoots that spring up about the stumps of trees that have been cut down. In Ceylon the young shoots are cut down twice a year: from these the bark is stripped in pieces about a foot in length. The outer and inner layers of this bark are scraped off, leaving a strip about the thickness of

BRANCH OF CLOVE TREE

writing paper. These thin strips are spread out in the sun and in drying roll up like quills. They are packed for market by slipping the smaller rolls into the larger ones, until rolls made up of several layers are formed. These are tied up in bundles.

The cinnamon from Ceylon is much the best. That sold by the grocers is not cinnamon at all, but cassia.

The cassia-tree is much like the cinnamon, only the bark is thicker, the flavor more biting and the odor stronger. The cassia buds look like little cloves.

Among the most important spices of the East are cloves. They are the unopened flower-buds of a tall tree. These small, red buds are gathered before

BLACK PEPPER.

they are quite unfolded, and dried as quickly as possible to keep the flavor from being lost.

They are usually dried in the air, but always in the shade. Sometimes they are partially dried over wood fires. In drying, the red color changes into a dark brown color.

Pepper is a *fruit*. The plant is a beautiful vine which sometimes grows as high as twenty feet. When the pepper does not grow wild — as it often does,

BRANCH OF CAYENNE PEPPER PLANT.

vines are set out and care is taken to plant trees near them, because the pepper plants love the shade and thrive best in it.

The vine does not bear until it is three or four years

old; then it produces two crops in a year. The fruit grows on a stem. When ripe the berries are red. Just as soon as a few berries are red upon the vines the harvest begins, because, should they be left until fully ripe, they would lose a great deal of their pungent taste.

BRANCH AND FRUIT OF NUTMEG TREE.

Some of the pepper-corns are simply dried, others are bruised and washed until the stems and outer covering can be removed, and then are dried.

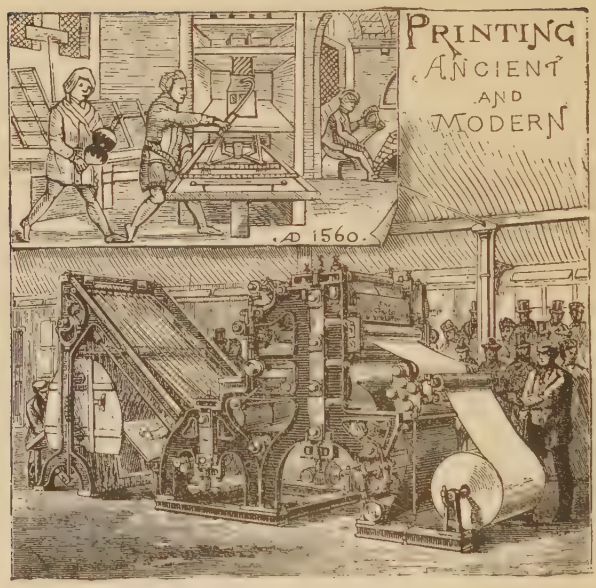
There are two kinds of pepper, white and black. That prepared by drying is simply black pepper. That prepared by removing the pulp is of a lighter color and is white pepper. White pepper is the most

delicate and expensive because of the labor expended upon it.

Two other spices are called pepper which are not pepper at all. One is known as Cayenne pepper, the other as pimento. Cayenne pepper is so called from a town of South America. It is often called red pepper from its color. The plant looks like the red pepper of our gardens.

The plant from which Cayenne pepper is obtained has a long small pod of yellowish-red when ripe. The ripe pods are dried, ground, mixed with yeast and baked in small hard cakes something like crackers. The cakes are ground up for market. Sometimes the pepper is prepared for market by simply pounding up the dry pods.

Nutmegs grow on a tall tree. The ripe fruit is yellowish and looks like a round pear. In a short time the shell bursts open in much the same way that our "square" nuts burst open the green outside coverings when the frosts come. When they are opened, the nutmeg can be seen encased in a red covering. This red covering is called the aril and, when ground, is known as mace. Within the aril is the nutmeg shut up in a shining brown shell. After the aril is removed the nuts are dried for about two months over very slow fires. When they are well dried they rattle about freely in their shells.



NEWSPAPER PRESS.

PAPER AND PRINTING.

AND now for a last trip through this wonderland prepared for us by man's genius and intelligence, let us study a little of the progress of printing and book-making from ancient times up to the present day.

In olden days, hundreds of years before you and I were born, there were no schools for boys and girls, where they might learn of things that were

strange and unfamiliar to them. In the days of ancient Britain, the young people gathered around some fine old tree, and listened to words of wisdom from the white-haired men, whom they were taught to respect — the Druids, of whom you read in English

History, who spoke to them of love for their country, as your teachers now speak to you of yours. By listening to them, they committed to memory an immense amount of tradition in matters of history, poetry and religion.

There were no books in those days, and people must

have greatly felt the need of some mode of fixing facts without trusting to the varying and fading powers of memory.

Later on, picture-writing, or the expression of ideas by drawings of objects, appears to have been the stepping stone to the letters now used in writing and even in our day the Chinese still employ single signs for whole words.

Such, too, were the sacred engravings or hieroglyphics of Egypt, the arrow-head writings of Nineveh and Babylon, the picture records of the Aztec, and of the Incas, who ruled Mexico and Peru, before the days of Cortes and Pizarro. Hermes, who lived two thousand years before Christ, has the credit of inventing hieroglyphics, but it is more than likely that some of the clay tablets at Nineveh are older than the oldest inscriptions of Egypt.

These earliest forms of writing were at first only impressed in soft clay, and baked in the sun; but they were afterwards cut in stone or metal.

The next step in the advancement of knowledge was the preparing of *papyrus* in a form for writing, and it is to these records, which they folded in the bandages of their embalmed dead bodies, that we owe much of our knowledge of the country, and the manners and customs of the inhabitants. How little we think of the great benefit conferred by the genius of

the inventor of this important preparation! His name is utterly lost, but his intelligence served to link with a chain of true history the events of the past and present of the human race.

Papyrus, from which we derive the term paper, was

prepared from the pith of a rush or reed, growing on the banks of the Nile.

The light, cellular pith was cut with a sharp knife in a spiral, just as cork-cutters cut cork, and the Chinese their so-called rice-paper. When unfolded, as we unfold a roll of paper or bale of cloth, it spread out

into sheets which were pressed flat, several, one upon another, cemented by their own gum, as we make card-board of layers of thin paper and paste. These sheets of papyrus were written upon with a calamus or small reed, and with ink made of ivory black and

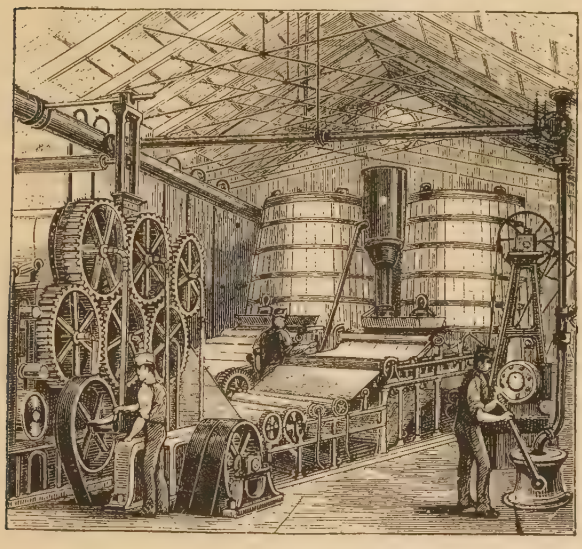
MONK ILLUMINATING MISSAL.

resin. Though so fragile a substance, many papyrus records have outlasted the obelisks of Egypt and the baked tablets of Nineveh.

Rock inscriptions were common long after papyrus had been applied to writing. Moses wrote the commandments on two tables of stone; a fact pointing

out that the Hebrews had learnt the art of writing during their sojourn in Egypt, an art which they did not possess when they entered that country.

The Greeks and Romans used tablets of wax, written



PAPER-MAKING MACHINERY.

upon with a style, or metal point, even while importing papyrus from Egypt.

In the last centuries, before the birth of Christ, parchment, prepared from the skin of the goat, and vellum, from the skin of the lamb and calf, began to take the place of papyrus. The Persians, however, are stated to have written their annals on vellum at a

much earlier date. Many of the oldest and most valued manuscripts are of this durable substance.

The writers and copyists of the Dark Ages were monks and priests, those patient, self-denying men, who to keep the lamp of knowledge burning, covered myriads of skins with their learning in the most perfect and patient penmanship and illuminated writing.

Printing has not spoiled the art of writing nor lessened its need. Printing and writing together have not injured the art nor lessened the need of speech. There are more good writers in our days, and more good speakers, than ever before. Speech has been improved by reading, which the art of printing has placed within the reach of all.

The paper which we now use is made from rags of cotton and linen. After the rags are sorted they are beaten and dusted by machinery. Now they are ready for the boiler, a great, upright iron cylinder, with a perforated false bottom upon which the rags rest. It has a filling door at the top, and an emptying door at the bottom. After being charged with the bits of rags, it is filled to about half its height with water; a little soda is added and the door shut. Steam is let into the cylinder by means of pipes, and the rags are boiled for ten or twelve hours. Then the steam is turned off, the liquid drawn away, the rags washed in cold water, and taken out

through the emptying door into trucks, to be picked over again. And now a great engine is half filled with water and packed with the boiled rags. The bars revolving seem to be angry, and beat and slash the rags at a great rate till they are quite clean, the water passing off underneath. At last the rags are not only clean, but bear no resemblance to cloth and lie there a soft snowy pulp. This pulp is beaten with machinery for hours, while china-clay or pearl-white is added, and, to size the pulp, a mixture of resin, soap, starch, etc.

Strange as it may seem, some color must be added to the pulp or it will not be a pure white. For this purpose red and blue coloring matter are used. Impurities are now taken out by machinery. The pulp, allowed to flow into great open boxes, is rolled with a roller at the top. Now the half dried pulp passes through rollers and begins to look something like paper. Freed by these rollers from water, the paper is passed on to heated and polished cylinders. This makes the web of paper smooth and glossy. Now the paper is wound on a reel all ready to be cut into convenient sizes for the printer's use.

Block printing was the earlist mode of taking impressions on paper. A design cut in wood was evenly covered with color, whereby the printer could transfer it by hand-pressure on to a sheet. This art was a

great step in advance of the slow plan of copying books with the pen. It was introduced about the middle of the fifteenth century as a new discovery, though the Chinese — we might almost say, of course —had printed for ages by this means, and still con-

CAXTON AT HIS PRINTING PRESS.

tinue to do so. You can see examples of their printing in the paper, printed only on one side, which covers every chest of tea.

A German named Gutenberg, about the year 1440 cut metal letters or types by hand, and printed the

Mazarine Bible, the first edition of the Scriptures in movable type. William Caxton was the first letter-press printer in England, and his earliest work was "The Game and Playe of Chesse," printed about the year 1470.

The types up to this date, and to the close of the century, were all in Gothic character, or **Black-Letter,** still printed from in Germany. Roman letters were brought in in 1500. Cranmer's Bible, in these simple characters, and in native English, appeared in 1539.

Printing was first introduced into America at Mexico in the year 1536. The first book printed was in the Spanish Language, and no copy of it is known to exist. The oldest American book of which a part may still be seen is the *Manual de Adultos*, of the year 1540, and of this only the last four leaves are in existence in the library of the Cathedral of Toledo.

The first printing-press used in North America was put up in Cambridge, Mass., about the year 1638. It was a very primitive affair compared with hundreds of modern inventions that are now in use in the same city, but in those days the work performed was considered very valuable and ingenious.

You all remember reading of how our great and wise Benjamin Franklin, when he was a boy, longed to be a printer, and of his early struggles to own a

press of his own. Here we have a picture of him working away at his press, and can see how proud and happy he looks.

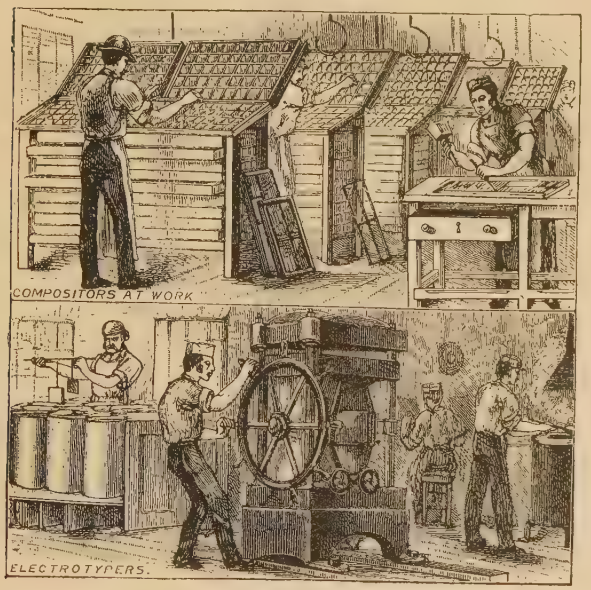
For a long time after the introduction of printing,

FRANKLIN WORKING AS A PRINTER.

the printers themselves cast the types they used, and printed and bound the works executed in their own establishments, and it was not till about 1735 that the first type-foundry was established in Pennsylvania, at

Germantown. There are now twenty-six type-foundries in the United States.

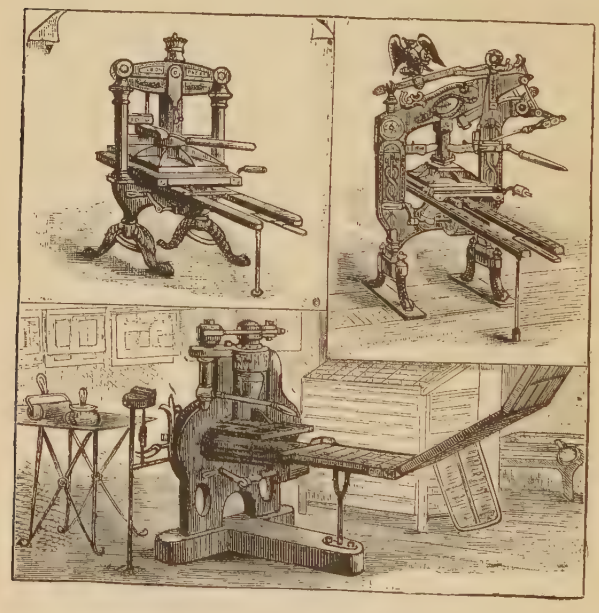
That composition, which we all admired so much, and which was considered so good that it was printed in last month's paper had to go through a great deal



of handling before we could read it in print. First it was taken to the "composing room," the place where the type-setting is done. There it was given to a compositor, who placed it in front of him on his case, so that he could read it easily, and proceeded to "set it up" in type. Each letter, as required, he took

from his case, which is divided into shallow compartments each holding a supply of the letters of the alphabet, figures, and other signs needed in printing.

Then an impression of it was taken from the types



OLD STYLE PRESSES.

upon paper, which was the proof-sheet, and as both author and printer often make mistakes, this required to be very carefully read and corrected, before the matter could be trusted in the paper where all the world could read it.

MAKING PRINTER'S TYPE.

We have learned of paper and printing; now we will learn something more about those smart little types which do so much for our enlightenment and pleasure.

In every complete assortment of printing types, there is about two hundred and fifty pieces, counting the capitals and small capitals, italic, figures, punctuation and reference marks, etc., and plenty of these different pieces must be kept for each different style of type.

There are hundreds of kinds, too, for ornamental work.

Types have little nicks low down on the body of the metal, so that the compositor, the man who sets them up, can readily see how to place them right side up. A small grove is taken out of the bottom, so that each type, when arranged in pages or columns, will stand on its "feet."

Think how exactly each of these little pieces must measure and "fit."

A famous foundry for making type is the Boston Type Foundry of that city. The proprietors of this foundry will be pleased, at any time, to show teachers and pupils the various processes of type-making.

There are five kinds of metals used by type founders. These are made of lead, copper, tin and antimony. The "quadrates" which were laid in where you see the white spaces in this printed page, are made of the cheapest metal; the small types, however, are made of the most expensive metal, to insure their being hard and tough.

Each of the type-casting machines takes up about as much room as does the sewing machine in your home.

The operator turns a crank, which brings the mould up to a little spout from which the melted metal is forced into the mould; the mould flies back and drops

its type. The whole operation is repeated with every turn of the crank.

Plain newspaper types come out of the machine as fast as 100 or more a minute; but ornamental types, a good deal slower.

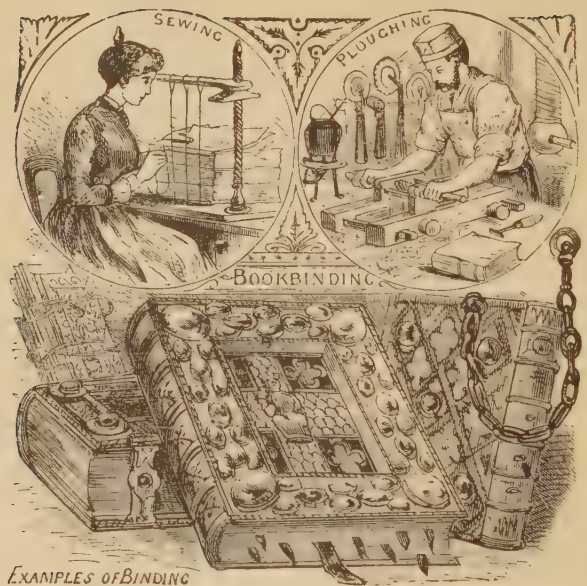
In all scripts, where a portion of the letter is extended, the work has to be done slowly to prevent it from being broken off.

Each type as it drops from the mould, has a little surplus metal attached to the foot of it. These are broken off singly by boys, and men rub the edges of the type on stones to remove any roughness of the edges.

The casters, dressers and finishers are all paid so much a pound for their work according to the size and style of type.

But these type-making machines have to be made themselves: this is done in another apartment and the matrices and moulds fastened into their places. It takes a good many pieces to cast a mould for a type no larger that a pin-head, and these must be made as true and exact as the works of a fine watch.

In another room are made the brass rules which are always used between the columns of newspapers and for dashes between the articles. The facing and finishing of ordinary rules is done by hand with planers, but for making wave rules and ornamental dashes different kinds of steel cutters are used.



EXAMPLES OF BINDING

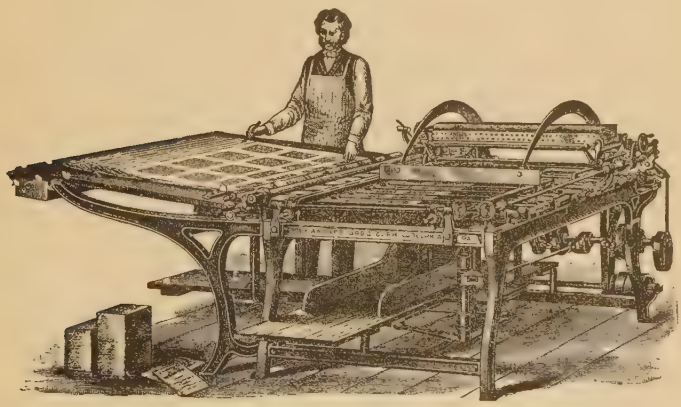
BOOK-BINDING.

AFTER printing, the books are folded, some by hand, many by machinery.

The machines will fold the sheets about as fast as a feeder can supply them.

After the folding comes the gathering or the putting together of the different sheets which make a book. Now, because the sheets were printed and folded so rapidly, they are not pressed firmly together

as they appear in your nice, new, school books. To make them lie perfectly flat they are put into a "smasher" which squeezes them so tight that the books becomes almost as hard as a board, and only an outside leaf in a pile of many thousands will be loose.



FOLDING MACHINE.

The books next go to a machine where two or more shallow cuts are made in the back edges, just enough to allow room for a strong cord to pass through.

Cords are arranged upon frames at distances just right to pass through the cuts in the book.

After sewing, the edges have to be trimmed in a cutter; the back is rounded by another machine.

Then the covers. How wide your eyes would open with astonishment could you see how deftly they are handled!

A particular kind of muslin made for the purpose is used for all "cloth" bindings.

It is cut enough larger than the two sides and back of the book to admit its being turned over at the edges. The paste-board foundation is generally cut out by machinery.

GATHERING THE SHEETS.

A workman will lay out a dozen of the pieces of muslin, brush them thoroughly with glue, place the paste-boards in position, put in a piece of stiff card-board or paper, fold over the edges and whisk the whole pile into a press almost before you have made up your mind what he is about.

The stamping or lettering in gold on the covers is done with a heated stamp.

The embossing or pressing the design upon the covers, plain or with ink, is done with a powerful press.

While held there the edges, held evenly and closely, are brushed over with a thin sizing of isinglass glue,

BOOK-BINDING.

and the gold leaf is laid on and burnished with a hot iron.

After this, the book is ready for the finisher, who puts on the cover and a beaded or corded trimming round the top, if desired.

If we look at a well-printed book, we see that the type on one side of a page is exactly even, line upon

line, with the type on the other side. This is called accurate or true register. It prevents the ink from showing through the paper and blurring the pages.

When we compare the first rude attempts at printing, and the first books printed, Chinese fashion, on one side only, because of the poorness of the paper, the thinness of the ink, and the heaviness of the blocks that made the impression — when we compare these with the books of to-day, then, and then only, can we realize the course and strides of intelligence in this direction.

Books upon books are issued, superbly bound, and illustrated with engravings in the highest style of art. Railway stations, at home and abroad, are furnished with book-stalls, to spread the earliest daily intelligence among high and low, and to while away the traveler's hours.

The Athenians of old, who spent their time in nothing else but either to tell or hear some new thing, could not have been more eager for news than our own age. We are eager to learn the affairs of every day in the State and in trade. We like to know what is going on abroad as well as at home, and every boy and girl may, with the advantages offered on every hand, become well-informed, intelligent men and women, "pioneers" in the march of their race towards a still higher civilization.